VALIDATION OF MODIFIED POSSUM SCORING SYSTEM IN PERFORATIVE PERITONITIS

Dissertation submitted to

The Tamil Nadu M.G.R Medical University

Chennai- 600032

In partial fulfillment of the

Regulations of the award of degree of

M.S. General Surgery

Department of General Surgery

Coimbatore Medical College Hospital

Coimbatore - 641018

APRIL 2014

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"VALIDATION OF MODIFIED POSSUM SCORING SYSTEM IN PERFORATIVE PERITONITIS"** is a bonafide and genuine research work carried out by me under the guidance of **Prof. Dr. D.N. RENGANATHAN M.S,** Professor of Surgery, Department of General Surgery, Coimbatore Medical College and Hospital, Coimbatore.

DATE: **Signature of the candidate**

PLACE: COIMBATORE **Dr. Ambarish Chatterjee**

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This is to certify that the dissertation entitled **"VALIDATION OF MODIFIED POSSUM SCORING SYSTEM IN PERFORATIVE PERITONITIS"** is a bonafide research work done by Dr. Ambarish Chatterjee in partial fulfilment of the requirement for the Degree of M.S. in General Surgery.

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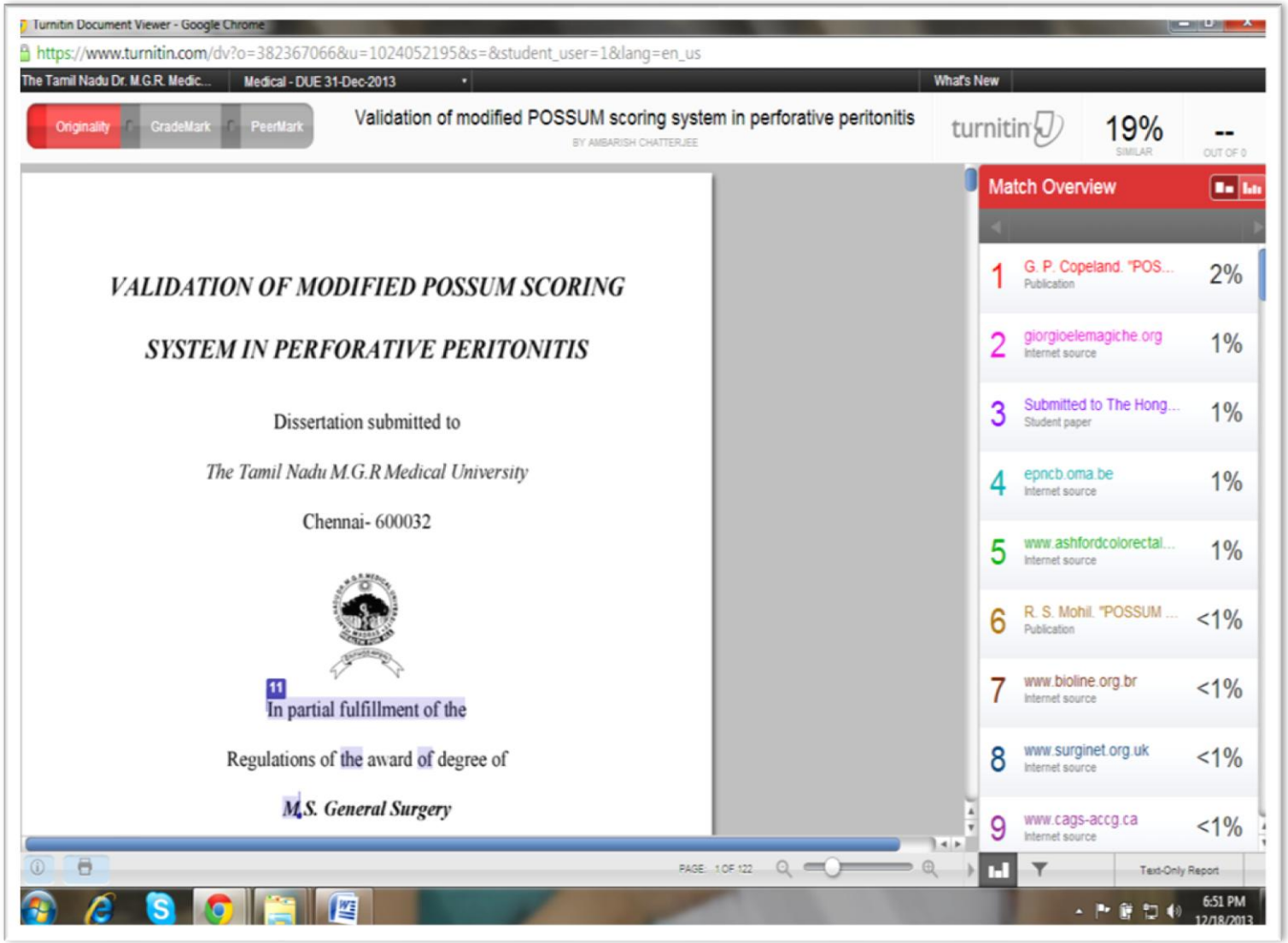
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DATE: Signature of the candidate

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CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

ABSTRACT

Background and objectives: Perforative peritonitis carries considerable morbidity and mortality. Even if patients reach the hospital at the earliest, still the post operative period is unpredictable most of the times. It therefore becomes necessary for a scoring system that predicts the post-operative period. POSSUM *(Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity)* helps in predicting the post-operative morbidity and mortality in these patients. POSSUM scores are calculated on the basis of 12 physiological factors and 6 operative factors. In our study we have included two more factors which are specifically important in perforative peritonitis. These two factors are the perforation to operation time, which is the time duration between the occurrence of perforation and operation; and the presence of co-morbidity. The presence of these factors significantly affects the post-operative status of the patients. Through this prospective study we can predict which patients are at a higher risk of death or complication and give appropriate management as necessary.

Methods: In this study, the sample size was 50 patients admitted in Coimbatore Medical College and Hospital, who are diagnosed with peritonitis due to hollow viscus perforation. Data was collected based on factors of POSSUM scoring system. Outcome of the patients was recorded as death / alive; complicated /

uncomplicated and statistical analysis was done by comparing the expected and observed outcomes.

Results: By applying linear analysis, an observed to expected ratio of 1.005 was obtained for mortality rate and 1.001 for morbidity rate. There was no statistical significant difference between the observed and expected mortality rates (χ^2 = 3.54, p = 0.316) and morbidity rates (χ^2 = 2.40, p = 0.792). It was found to be comparable to other studies. Two factors were independently studied; perforation to operation time and presence of co-morbidity. A statistical significance was established between these two variables and the outcome. ($p<0.05$)

Interpretation and Conclusion: POSSUM scoring system is a good indicator of post operative outcome in surgeries performed for perforative peritonitis and was applicable in our setup. It may be used in identify high risk patients and give preferential care to these patients for better outcome. Inclusion of factors like perforation to operation time and co-morbid status can improve the scoring system. Hence a modification in the scoring system according to the surgery will more improve the outcome of the patients and better care can be provided to them.

Key words: POSSUM; perforative peritonitis; perforation to operation time; co-morbidity.

LIST OF ABBREVATIONS

POSSUM	–	Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity
P-POSSUM	–	Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity
ASA	–	American Society of Anaesthesiologists
J-POSSUM	–	Jabalpur Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity
APACHE	–	Acute Physiology and Chronic Health Evaluation
ROC	–	Receiver Operative Characteristic
χ^2 test	–	Chi square test
SIRS	–	Systemic inflammatory response syndrome
MODS	–	Multiorgan Dysfunction Syndrome

INTRODUCTION

Even in modern era, perforative peritonitis has a high mortality and morbidity. Peritonitis developing as a result of hollow viscus perforation is a common condition in a developing country like India. Even if the patient reaches the hospital in time and is operated, the post operative period is still unpredictable.

Secondary peritonitis is the consequence of contamination of the peritoneal cavity due to contents of organ within the peritoneal cavity. Majority of these episodes are due to lesions in stomach, duodenum, small intestines, appendix and colon [(1)]. Mortality due to hollow viscus perforation ranges from 10% to 40 %[(2)]. Due to delay in operative intervention and co-morbidities, there is significant post operative mortality and morbidity. In surgical practice, where major invasive procedures are being performed, audits are mandatory for improving the standard of care as well as indicator for allotting resources [(13)].

POSSUM would help to identify those patients who are at increased risk of developing complications and death. POSSUM was developed by Copeland et al in 1991[(14)]. Numerous scoring systems have been developed such as ASA (American Society of Anesthesiologist) [(15)] for general risk prediction, APACHE III (Acute Physiology and Chronic Health Evaluation III) [(16)] for intensive care, Goldman Index [(17)] for cardiac related complications peri-operatively and ACPGBI (Association of ColoProctology of Great Britain and

Ireland) [18, 19]. These scoring systems have provided an objective assessment of patients' health and therefore a meaningful comparison can be made. However, surgeons are more aware of POSSUM than these scoring systems, since ASA is too simple and highly subjective whereas APACHE is too complex for general use. For general surgical procedures POSSUM and its subsequent modifications incorporate physiological, operative and pathological information and provide a comparison of outcomes between surgeons, units and healthcare systems [20, 21].

POSSUM was developed by Copeland et al from a cohort of 1372 patients in 1991 mainly for surgical audits. It is a scoring system based on 12 pre-operative physiological factors and six operative factors. Each factor is scored with 4 graded score values; the sum of individual scores was used to predict 30 days' post-operative morbidity and mortality after deriving equations from logistic regression analysis [14].

The P-POSSUM is a modification of POSSUM, which incorporates the same variables and grading system, but a uses a different equation, which provides a better fit to the observed mortality rate [21]. It has already been used in general [22], vascular [23- 26], colorectal [27- 29], esophageal [30] and laparoscopic [31] procedures. But the studies mostly have been done in developed countries where patient characteristics, presentation and hospital resources differ from our setup [32].

Hence, there is a need to validate POSSUM in Indian scenario where problems like delayed presentation and limited resources can affect the outcome even with adequate quality care [33- 35].

This study was undertaken to assess the validity of POSSUM scoring system in patients with perforative peritonitis to analyze the post-operative outcome in this high risk group.

In our study we have analyzed two more variables; perforation to operation time and presence of co-morbidity as these factors significantly affect the outcome in patients with perforative peritonitis.

AIMS AND OBJECTIVES

AIM:

To assess the validity of modified POSSUM score in perforative peritonitis.

OBJECTIVES:

1. To assess the validity of POSSUM scoring in predicting post-operative morbidity and mortality in patients who undergo emergency laparotomy for perforative peritonitis.

2. To validate two factors; perforation to operation time and co-morbid status in predicting the post operative outcome in patients with perforative peritonitis.

REVIEW OF LITERATURE

Intra-abdominal infections have been well known throughout the history of surgery. However, only in the last century there has been a significant progress in the treatment of this disease. Timely surgical intervention has been one of the major reasons behind this success. However, the reduction in mortality from 90% to 10 – 20% within a century cannot be credited to surgery alone [(2)]. Improved antibiotics along with the improvement in post operative care have been armamentarium in this progress. With improved imaging techniques, better localization and subsequent drainage of intra-abdominal abscesses has been possible. Despite this fact; mortality persists with most patients succumbing from sepsis and MODS. It is now clear that the most influential factor in managing these cases is early accurate diagnosis and treatment [(2)].

ANATOMY OF THE PERITONEAL CAVITY

The peritoneal cavity is divided into greater and lesser sacs which communicate with each other via the foramen of Winslow. The greater sac due to anatomic and physiological factors has number of potential sites where fluid can get accumulated. These are, the right subhepatic space, right and left subphrenic spaces, the paracolic gutters and the pelvis [(2)].

Right subhepatic space

The space is bounded by the inferior surface of right lobe of liver superiorly, the hepatic flexure and transverse mesocolon inferiorly, second part of the duodenum and hepatoduodenal ligament medially and laterally by the body wall. Posteriorly it opens into the Morison's pouch; the most dependent space in the peritoneal cavity during recumbence and is the most likely site for fluid collection.

Right subphrenic space

This space is between the right hemi-diaphragm and the superior surface of the right lobe of liver, medially by the falciform ligament and posteriorly the right triangular and coronary ligaments.

Left subphrenic space

This is a large space that extends from above the left lobe of liver, is posterior to spleen and also antero-inferiorly beneath the left lobe of liver. It has two components; subphrenic and the subhepatic. The subphrenic component lies between the left hemi-diaphragm and left hepatic lobe and medially by the falciform ligament; postero-medial border consists of the left triangular ligament of the liver; laterally it extends between the diaphragm and the spleen. Inferiorly it extends to the space between spleen and kidneys. The subhepatic

component is defined antero-superiorly by the inferior surface of the left hepatic lobe and posteriorly by the anterior wall of the stomach and the lesser omentum.

Paracolic gutters

These spaces lay between the body wall and the ascending colon on right and descending colon on left. On the left, the communication of the paracolic gutter with the subphrenic space is limited by the phrenocolic ligament and inferiorly the communication with the pelvis is prevented by sigmoid colon. However on the right the communications exists between right paracolic gutter, right subphrenic and subhepatic spaces and the pelvis.

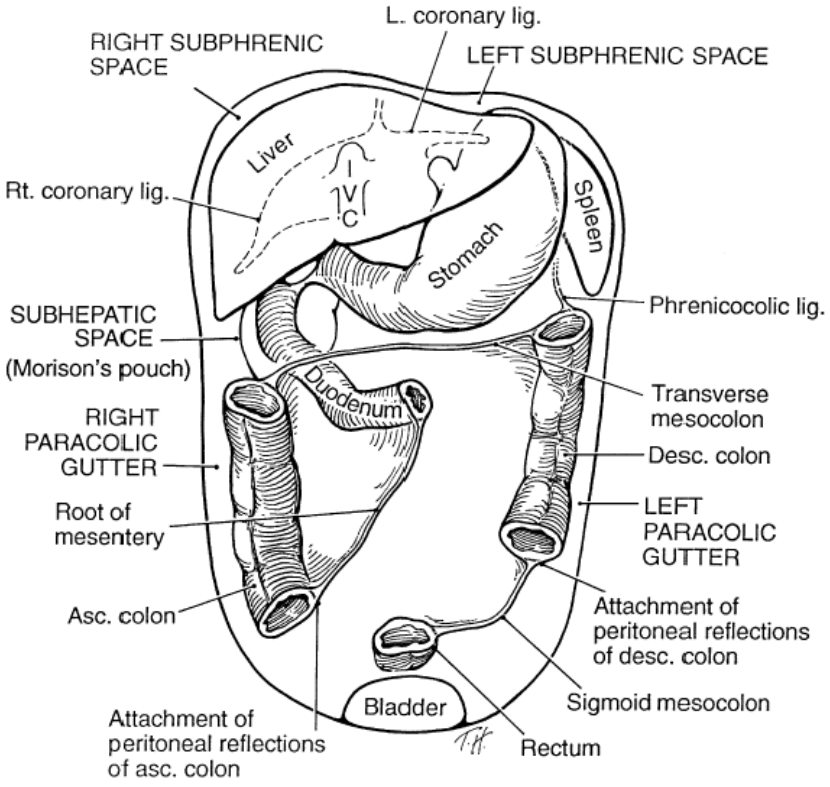
Pelvic cavity

The pelvic space is most dependent space within the peritoneal cavity in upright and recumbent posture. Anteriorly it is defined by the urinary bladder, posteriorly by the rectum, bony pelvis and retroperitoneum. In females, the pelvic cavity is subdivided into anterior compartment, uterovesical pouch and posterior compartment, rectovesical pouch. The rectovesical pouch is the most likely location of a pelvic abscess.

Lesser sac

The lesser sac lies posterior to stomach and gastrohepatic ligament. Superiorly it is bounded by the caudate lobe of the liver, inferiorly the transverse mesocolon. Pancreas forms the deep posterior border of the lesser

sac. Despite free communication between the greater sac and lesser sac, infections originating in the greater sac uncommonly extend to the lesser sac. Infections in this space usually arise from stomach and pancreas.

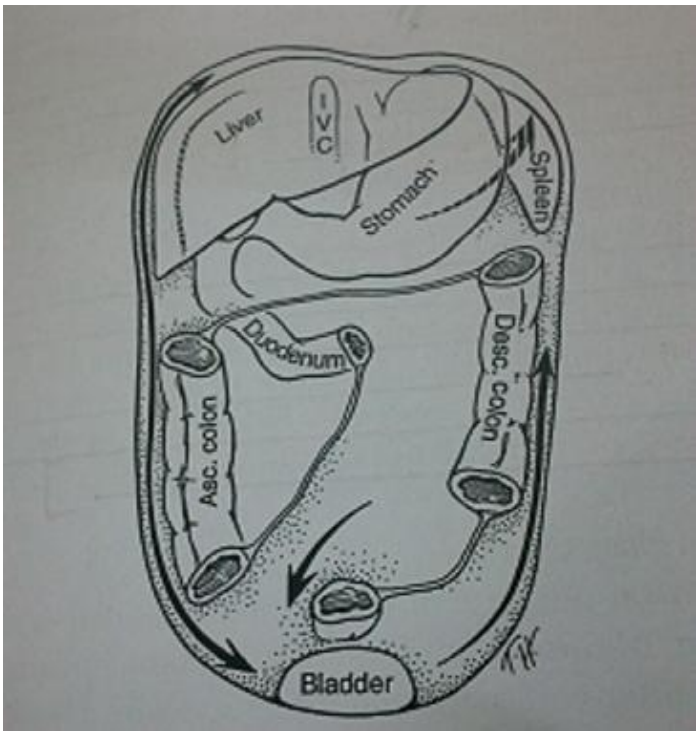


PHYSIOLOGY OF THE PERITONEAL CAVITY

The peritoneal cavity is lined by a single layer of mesothelial cells with basement membrane supported by highly vascular connective tissue [(3)]. The surface area of the peritoneum is averaging 1.8m^2 in an adult male [(4)]. With 1mm increase in the thickness of the peritoneum by fluid accumulation, it can result in the sequestration of about 18 litres of fluid which relates to the massive fluid shifts associated with diffuse peritonitis[(5)]. In males the peritoneum forms

a closed sac while in female it is continuous with the fallopian tube mucus membrane.

About $1m^2$ of peritoneum functions as a passive, semi-permeable membrane to the diffusion of water, electrolytes and macromolecules. Normally <50ml of sterile fluid is present in the peritoneal cavity and it closely resembles lymph fluid with a low specific gravity, low protein content and <3000 cells/mm^3. Contrast material injected into the peritoneal cavity in the paracecal area transmigrates towards the right subphrenic space and pelvis [6].



The cephalad movement is produced by the negative pressure in the subphrenic space produced by the diaphragmatic motion. Most of the peritoneal fluid is absorbed via the parietal peritoneal surface into the lymphatic circulation, with the remainder absorbed through the diaphragmatic lymphatics [7]. The clearance

of the particulate matters, microorganisms and cells is largely by the diaphragmatic lymphatics [8]. The diaphragmatic lymphatics ultimately drain into the thoracic duct. Based upon animal models, following intra-peritoneal injection of bacteria, organisms can be recovered from the right thoracic duct within 6 minutes and from the blood within 12 minutes [9]. The two main defence mechanisms in clearing bacteriae from the peritoneal cavity is the diaphragmatic clearance and phagocytosis by resident peritoneal macrophages. These remain the first line of clearance after bacterial contamination.

LOCAL RESPONSE TO PERITONEAL IRRITATION

The classical response is characterized by hyperaemia of the peritoneum, influx of fluid, recruitment of phagocytes and by fibrin deposition. The earliest physiological response is increase in local blood flow and influx of fluid. Although the classical stimulating agent is endotoxin produced by gram negative bacteriae; other organisms such as gram positive bacteriae, Bacteroides species and yeasts also produce similar response. The systemic effects such as hypotension, fever, leucocytosis, platelet aggregation and shock are brought by tumour necrosis factor (TNF) and interleukin-1 (IL-1) mainly. Non-infectious irritants such as gastric juice, pancreatic juice, bile, urine and meconium cause sterile peritonitis. They initiate inflammatory process by causing mesothelial damage or direct activation of the complement system [2].

PERITONEAL HEALING

The rate by which the peritoneal heals is independent of the size of the peritoneal wound. Within 3 days the wound is covered by connective tissue cells, and by 5^{th} day new cells resemble normal mesothelium [(2)]. The peritoneal injury in presence of infection and inflammation results in adhesions. As the inflammation resolute fibrinous adhesions are degraded and removed by normal fibrinolytic activity. With persistent infection, the filmy fibrinous adhesions are transformed to fibrous adhesions by fibroblasts, capillaries and collagen deposition.

PERITONITIS

Inflammation of the peritoneum can be caused by bacteriae, fungi, viruses, chemical irritants and foreign bodies. Peritonitis is divided into three types based on the source and nature of microbial contamination [(2)].

1. Primary peritonitis: Infection usually mono-microbial, extra-peritoneal source and without visceral perforation. For example; conditions such as tuberculosis, alcoholic cirrhosis, nephrotic syndrome, renal failure and systemic lupus erythematosus.
2. Secondary peritonitis: Most common form, intra-peritoneal source usually a perforation of hollow viscus.

3. Tertiary peritonitis: It develops following treatment of secondary peritonitis and represents a failure of the host defence response or superinfection.

SECONDARY PERITONITIS

Secondary peritonitis is due to contamination of the peritoneal cavity from an organ within the peritoneal cavity. The majority are due to lesions in the stomach, duodenum, small intestine, colon and appendix. Approximately 10% are caused by complications of abdominal surgery. The mortality rate ranges from 10% to 40% in these cases [(2)]. The condition related mortality differs such as that due to perforated duodenal ulcer and perforated appendicitis is low, 0% to 10%; while due to intestinal perforation and conditions of biliary tract is higher 20% to 40%. Mortality in peritonitis due to anastomotic leak approaches 30% [(5)]. The outcome is influenced by factors such as advanced age, renal, cardiac, hepatic, or pulmonary status, malignancy and diabetes. All these factors cause threefold increase in mortality. Wittman noted that a delay in 6 hours prior to treatment can increase the mortality rate from 10% to 30% [(5)].

MANAGEMENT OF SECONDARY PERITONITIS

The primary objectives in the treatment of secondary peritonitis are: (1) Resuscitation, (2) antibiotic therapy, (3) elimination of source of bacterial

contamination, (4) reduction of the bacterial inoculums and (5) metabolic support.

Resuscitation: The rate at which resuscitation is accomplished is determined by the degree of hypovolemia and the physiological status of the patient. The effectiveness of fluid management is estimated by the urine output, pulse rate, blood pressure and mental status. Central cardiac pressure monitoring catheters, supplement oxygen, airway protection and a nasogastric tube to decompress in the presence of ileus. Proton pump inhibitors must be administered to prevent stress gastric ulcers.

Antibiotic therapy: The initial antibiotic therapy should be empirical. The microbial contamination depends upon the involved portion of the gastrointestinal tract. Oesophageal perforations involve gram-positive cocci and anaerobes. The stomach and duodenum, under normal circumstances are colonized by lactobacilli and yeast. However, perforations of the stomach and duodenum usually results in chemical peritonitis due to acid injury rather than bacterial peritonitis. Perforations of the small intestines and colon result in polymicrobial contamination due to diverse flora of the intestine. The number of bacteria per gram of intra luminal contents in the colon varies from 10^7 in cecum to 10^{12} in rectum, the anaerobe to aerobe ratio being 100:1 [(10)]. 76% of patients with peritonitis have mixed organisms, with Escherichia coli and

Bacteroides fragilis the most common combination [11]. Presumptive therapy should cover both aerobic gram negative rods and anaerobic organisms.

For mild to moderate intra-abdominal infection [2]: Second or third generation cephalosporin or β lactamase inhibitor combination or monobactam and metronidazole.

For sever intra-abdominal infection without renal dysfunction [2]: Carbapenem or Fluoroquinolone and metronidazole or aminoglycoside and metronidazole with / without ampicillin.

For severe intra-abdominal infection with renal dysfunction [2]: Carbapenem or fluoroquinolone and metronidazole.

Surgical management: Operative management should be directed to the control of the source of contamination. It is accomplished by closure of the perforation, resection of the hollow viscus, or exclusion of the organ from the peritoneal cavity. The second goal of operative management is to reduce the bacterial inoculums. The standard procedures include swabbing, debriding fibrin, blood and necrotic material and copious irrigation of the peritoneal cavity. Special attention should be given to the peritoneal spaces.

COMPLICATIONS OF PERITONITIS [12]: The complications can be divided into systemic and abdominal.

Systemic complications include:

1. Bacterial / Endotoxic shock
2. SIRS
3. MODS
4. Death

Abdominal complications include:

1. Paralytic ileus
2. Residual or recurrent abscess and / or inflammatory mass
3. Portal pyemia and / or liver abscess
4. Adhesional small bowel obstruction

Even with modern care, the mortality rate following peritonitis is from 10% to 40% [22, 2]. Hence, it becomes necessary to identify individuals who are at high risk for death or complications and give preferential treatment to these individuals.

In many hospitals, the quality of care is assessed by discussing individual case or by reviewing a series of patients undergoing particular type of surgery. Comparisons between different surgeons, units, hospitals and regions are bedevilled by differences in patient characteristics, presentations, fitness and the nature of the surgery performed [14].

The Royal College of Surgeons of England defines audit as "the systematic appraisal of the implementation and outcome of any process in the context of prescribed targets and standards". The difficulty that lies in this definition is in interpreting prescribed targets and standards; it infers that the outcome for individuals and series of patients can be predicted. In this context,

probably morbidity is as important as mortality while discussing quality of care. In an audit, it is also important to discuss about individuals in whom deaths or complications were expected, but did not occur. Hence an audit should include 'surgical successes' in addition to mortality and morbidity rates, if it is to be educational [14].

The ideal scoring system for surgical audit should assess both mortality and morbidity in addition to surgical success. It should also be quick and easy to use and should be applicable to all surgical procedures whether elective or emergency. It should be useful in any hospital setup and provide educational information. It should also be possible to integrate the scoring system into pre-existing audit programs with minimum disruption [14].

Copeland G P analyzed 48 physiological and 14 operative factors over a period of 6 months to reduce the number of variables in an effort to create a simple, surgeon based risk adjusted scoring system. Finally 12 physiological and 6 operative factors were produced after further analysis of 35 factors for 6 more months. Multivariate discriminate analysis was then done to obtain multivariate discrimination function coefficients for each set of variables producing 12 factors, 4 grade physiological score and logistic regression analysis was done to derive 6 factors, 4 grade operative score [14].

PHYSIOLOGICAL AND OPERATIVE SEVERITY SCORE FOR THE ENUMERATION OF MORTALITY AND MORBIDITY (POSSUM)

	Physiological factors	**Operative factors**
1	Age (in years)	Operative complexity
2	Cardiac signs	Multiple procedures
3	Respiratory history	Blood loss
4	Blood pressure systolic (mmHg)	Peritoneal contamination
5	Pulse (beats/min)	Extent of malignant spread
6	Glasgow coma score	Elective versus emergency
7	Hemoglobin (gm/100ml)	
8	White cell count (x 10^{12} / l)	
9	Urea (mmol/L)	
10	Sodium (mmol/L)	
11	Potassium (mmol/L)	
12	Electrocardiogram	

Physiological scoring:

	SCORES			
	1	2	4	8
Age (in years)	≤ 60	61 – 70	≥71	-
Cardiac signs Chest radiograph	No failure	Diuretic, digoxin, antianginal or hypertensive therapy	Peripheral edema; warfarin therapy Borderline cardiomegaly	Raised jugular venous pressure Cardiomegaly
Respiratory history Chest radiograph	No dyspnea	Dyspnea on exertion Mild COAD	Limiting dyspnea (one flight) Moderate	Dyspnea at rest (rate ≥ 30/min) Fibrosis or

			COAD	consolidation
Blood pressure systolic (mmHg)	110 – 130	131 – 170 100 – 109	≥ 171 90 – 99	≤ 89
Pulse (beats/min)	50 – 80	81 – 100	101 – 120	≥ 121
Glasgow coma score	15	12 – 14	9 – 11	≤ 8
Hemoglobin (gm/100ml)	13 – 16	11.5 – 12.9 16.1 – 17.0	10.0 – 11.4 17.1 – 18.0	≤ 9.9 ≥ 18.1
White cell count (x 10^{12} / l)	4 – 10	10.1 – 20.0	≥ 20.1	-
Urea (mmol/L)	≤ 7.5	7.6 – 10.0	10.1 – 15.0	≥ 15.1
Sodium (mmol/L)	≥ 136	131 – 135	126 – 130	≤ 125
Potassium (mmol/L)	3.5 – 5.0	3.2 – 3.4 5.1 – 5.3	2.9 – 3.1 5.4 – 5.9	≤ 2.8 ≥ 6.0
Electrocardiogram	Normal	-	Atrial fibrillation Rate (60-90/min)	Any other abnormal rhythm or ≥ 5 ectopic/min, Q waves or ST/T wave changes

Operative scoring:

	Score			
	1	2	4	8
Operative severity*	Minor	Moderate	Major	Major +
Multiple procedures	1	-	2	> 2
Total blood loss (ml)	≤ 100	101 – 500	501 – 999	≥ 1000
Peritoneal soiling	None	Minimal (serous fluid)	Local pus	Bowel content, pus or blood
Presence of malignancy	None	Primary only	Nodal metastases	Distant metastases
Mode of surgery	Elective	-	Emergency resuscitation of	Emergency (immediate surgery

			>2 hours possible # Operation < 24 hours after admission	< 2 hours needed)

# indicates that resuscitation is possible even if this period is not actually utilized.

Surgery of moderate severity includes appendicectomy, cholecystectomy, mastectomy, transurethral resection of prostate.

Major surgery includes any laparotomy, bowel resection, cholecystectomy with choledochotomy, peripheral vascular procedure or major amputation.

Major + surgery include any aortic procedure, abdomino-perineal resection, pancreatic or liver resection, oesophago-gastrectomy.

The scoring system was then studied prospectively on 1,372 patients undergoing general surgeries using logistic regression analysis to obtain statistically significant equations.

Physiological score (12-48), Operative score (6-48)

POSSUM equation for morbidity:

Ln R/1- R = - 5.91 + (0.16 x physiological score) + (0.19 x operative severity score)

POSSUM equation for mortality:

Ln R/1 -R= -7.04+ (0.13 x physiological score) + (0.16 x operative severity score)

Where R = predicted risk

The predictive values of these equations were assessed and validated by the determination of receiver operating characteristic curves. It was concluded by suggesting a wider application of this scoring system to assess its validity in other surgeries and different setups [13].

Copeland G P [36] used the POSSUM in 344 patients undergoing reconstructive vascular surgery and assessed its efficiency in comparative audit between two units. They succeeded in predicting that POSSUM was a better predictor of adverse outcome following surgery. Estimated mortality rates of 10.2% in unit A (observed 9.4%) and 20.2% in unit B (observed 20.2%) were obtained and using ROC curves they found that there was no statistical significant difference between the two units. They concluded that POSSUM was a better guide for comparing efficiency of quality of care, compared to crude mortality rates.

Copeland G P [37] after analyzing the basis of comparative audit suggested POSSUM to fulfill the basic need of providing a good comparative audit for general surgical patients.

Jones D R [38] compared the efficiency of POSSUM and APACHE II scoring systems in predicting the adverse outcome in 117 patients in a general surgery unit, undergoing major surgery (elective and emergency). Pre-operative and intra-operative data was collected and patients were monitored for complications in the first 30 postoperative days. 13 patients (11%) died and

complications were seen in 50% patients. ROC curve analysis was performed to calculate predictive value of POSSUM and APACHE II scoring systems. POSSUM was better predictor of mortality (area under the curve 0.753) and morbidity (area under the curve 0.82) as compared with APACHE II (area under the curve 0.54) and a statistical significance was seen ($p < 0.002$). Hence POSSUM scoring system was recommended as an accurate predictor of post operative outcomes.

Sagar P M [39] validated POSSUM for predicting adverse outcome rate in colorectal resection and its uses in comparative audit. 248 patients who underwent colorectal resection in two different units were studied and POSSUM was applied. Mortality rate predicted by POSSUM in unit A was 5.2% (observed 6%) and in unit B 9.8% (observed 9%). The observed to expected ratio were nearly identical in both the units. They therefore validated POSSUM system in patients undergoing colorectal surgery and also its efficacy in comparative audit.

Sagar P M [27] used POSSUM to compare adverse outcome following colorectal resection in 438 patients among five surgeons. While the crude mortality rates were from 5.6% to 6.9% and morbidity rates were 13.6% to 30.6%, risk adjusted analysis using POSSUM proved no statistically significant difference and also the overall observed to expected ratio for mortality was 0.87 and for morbidity, it was 0.97. They thus concluded that meaningful comparison

of individual surgeon's efficiency is possible as POSSUM is a good predictor of adverse outcome.

Murray G D [40] suggested that there is a need for statistical remodeling for predicting the quality of care and comparisons using crude mortality rates were not a good method.

Whitely MS [22] from Portsmouth University evaluated POSSUM in 1,485 patients undergoing general surgical procedures. Mortality rate was used to compare the observed and expected rates as there were difficulties in defining morbidity and collecting data on complications. Mortality is also an objective measure of surgical outcome. The predicted deaths were 90, while the observed deaths were 37. They demonstrated an over prediction of by a factor of 2 by using the POSSUM scoring system and linear analysis as described by Hosmer and Lemeshow. In order to improve the predictive capability of the scoring system, they used linear regression analysis to derive a better equation, but using the same set of variables as described in the original POSSUM scoring system. For mortality it was,

$\text{Log } [R/1-R] = (0.1692 \times PS) + (0.155 \times OS) - 9.065$

Where R = risk of mortality.

The new modified Portsmouth POSSUM scoring system was created and which provided a better fit to the observed mortality rate (O: E ratio 1, χ^2 test 5.84, d.f., p = 0.1197). They, thus, concluded by suggesting geographical

comparison of POSSUM, which resulted in better application of risk adjusted scoring system.

Prythech D R [41] prospectively compared POSSUM and P-POSSUM in 10,000 general surgical patients between August 1993 and November 1995. POSSUM was applied to all 10,000 patients, while the first 1,500 patients were used to derive a modified P-POSSUM equation, which was then applied prospectively to the remaining cases. The POSSUM score over predicted the mortality rate by a factor of 2, the observed mortality rate was 287 deaths and predicted was 697 deaths, the P-POSSUM scoring system when applied prospectively on the subsequent 7,500 cases showed an observed to expected ratios of 0.90 (χ^2 = 1.63 5 d. f.,) and 0.85 (χ^2 = 1.35 4 d. f). They concluded by suggesting that application of P-POSSUM scoring system for predicting mortality and also emphasized the need for evaluation of geographical variation in predicting the adverse outcome rate.

Wijesinghe [42] compared POSSUM and P-POSSUM for predicting mortality following vascular surgery in 312 consecutive patients. Data for the first 30 day post operative days was collected, which showed 41 deaths. Analysis was done by linear and exponential methods for POSSUM and P-POSSUM, respectively. Using POSSUM they obtained an observed to expected ratio of 0.59 with linear analysis and 1.14 with exponential analysis. P-POSSUM revealed an observed to expected ratio of 0.89 using linear analysis. It was simpler and predicted the individual patient's mortality rate. They

concluded that POSSUM and P-POSSUM systems are accurate in predicting the mortality rate when the correct method of analysis was used for either system and the scoring systems were valid in general as well as in vascular surgery.

Menon K V [43] analyzed P-POSSUM in the outcome of methicillin resistant staphylococci aureus infected patients undergoing surgery. In 1132 patients of whom 30 were diagnosed with methicillin resistant staphylococci aureus. The outcome was compared with non infected group who having similar predicted mortality rate as per P-POSSUM. There was no statistical difference between these two groups. They therefore validated P-POSSUM as a means of standardizing patient data so that comparison could be made amongst diverse groups of patients.

Midwinter [44] compared POSSUM and P-POSSUM for mortality and morbidity rates in vascular surgery cases. 221 patients undergoing elective and emergency vascular surgeries by the same surgeon were studied. Overall mortality and morbidity rates were 6.6% and 57.6% respectively. The POSSUM scoring system showed a significant difference between observed and expected mortality rates (χ^2 test = 24.04, 6 d. f., $p < 0.001$), P-POSSUM scoring system showed better concordance between expected and observed mortality rates (χ^2 test = 9 6 d. f., $p = 0.17$). They thus concluded that P-POSSUM is a better predictor of post operative mortality rates. They also suggested that widespread application among different regions is needed to assess its validity and if a good fit was obtained; the equation can be adopted as a standard for risk adjusted

comparative audit as well as. It enables an individual surgeon or unit to assess the effectiveness of care provided.

Jones H J S and de Cossart L [45] conducted a meta-analysis of the various scoring systems available for risk scoring in surgical patients by comparing Goldman cardiac index, ASA, prognostic nutritional index, hospital prognostic index, APACHE II, POSSUM and P-POSSUM scoring systems. They suggested that POSSUM and P-POSSUM scoring systems could be used because of they can be easily applied, with use of routine preoperative investigations and could serve as an important risk scoring tool.

Treharne G D [25] used the physiological factors of POSSUM scoring system to compare the outcome among patients undergoing abdominal aortic aneurysm repair by conventional and endovascular procedures. 104 open surgery cases and 49 endovascular surgery patients were included in the study. P-POSSUM scoring system was used to study the two groups of patients to achieve comparability among the cohorts. Though the indications for the type of surgery depended upon the physiological status of the patient, using P-POSSUM scoring they were able to match the two groups. The O: E ratios of 0.75 and 0.86 for open and endovascular groups validated P-POSSUM scoring system for predicting the mortality rate which allowed the authors to conclude that endovascular method is better than conventional method.

Neary B [26] in a retrospective study with the use of physiological factors of POSSUM predicted the adverse outcome following intra arterial thrombolysis of acute leg ischemia, which is a non operative method. They found that the physiological component of POSSUM accurately predicted the adverse outcome rate. They suggested application of POSSUM in non operative cases also.

Tekkis P [28] analyzed mortality in gastrointestinal surgery patients using POSSUM and P-POSSUM scoring systems. A total of 505 consecutive patients who underwent major gastrointestinal surgeries (elective 66.1%, emergency 33.9%) were analyzed. The observed mortality rate was 56 deaths, and the expected mortality rate using POSSUM was 108 deaths, which they found to be a significant over prediction (χ^2 test = 44.82, 4 d.f., $p < 0.001$). When P-POSSUM was used, the expected rate was 57 (χ^2 test = 3.34, 4 d.f., $p < 0.51$). Comparison suggests P-POSSUM as the recommended scoring system.

Bann S D and Sarin S [46] assessed the validity of POSSUM scoring using the hospital based on protocols for investigations and excluded patients with incomplete data. They found there was a significant lack of fit to the observed mortality rate. They suggested clarifications regarding the applicability of POSSUM and P-POSSUM in general surgical patients.

Yii M K and Ng K J [32] evaluated POSSUM and P-POSSUM scoring systems for predicting mortality rates in patients undergoing general surgery in a tertiary referral hospital in Malaysia. Aim was to assess its applicability in

their scenario of a developing country. The observed rates among four different risk subsets were 6.1%, and the POSSUM system predicted 10.5% showing a significant difference ($p < 0.01$). The predicted mortality by using the P-POSSUM was 4.8% which showed a good fit to the observed rate. They concluded by validating P-POSSUM as an effective tool for predicting the adverse outcome rate in the Malaysian scenario. They suggested further studies to validate P-POSSUM, in other developing countries to allow for accurate comparison of data.

Organ N in a retrospective study, evaluated P-POSSUM scoring in 221 patients who underwent surgery to test its effectiveness in an Australian scenario. Assessment was done using linear analysis and ROC curves. They noticed a significant difference between the observed mortality rates (28) and the predicted rates (49.9). They concluded that there was a high discordance to warrant the applicability of P-POSSUM for routine assessment of expected mortality rates. They suggested further studies for local calibration in Australian conditions to arrive at a more effective risk adjusted scoring.

Copeland G P [47] explained the genesis of the POSSUM and described the correct method to analyze it. He suggested the usage of POSSUM to identify high risk patients, who may benefit from preoperative and per-operative optimization to provide better surgical care to the patients. He concluded by suggesting a wider application of POSSUM in various surgical specialties and

other countries too, to assess the quality of care by using the difference in the O: E ratio.

Shuhaibar J H [48] compared POSSUM an P-POSSUM scoring in predicting mortality rates following infra renal abdominal aortic aneurysm repair surgery. 118 patients were included and outcomes were compared using POSSUM, P-POSSUM and the length of hospital stay hypothesis. The O: E ratio was 1.24 for POSSUM and 0.71 for P-POSSUM. They thus validated P-POSSUM and POSSUM scoring system for prediction of post operative mortality rate.

Zafirellis K D [30] assessed the applicability of POSSUM scoring system in predicting mortality rates in patients of esophageal carcinoma, who underwent esophagectomy. A total of 204 patients were studied retrospectively and using linear method of analysis they found the observed and expected mortality rates were 12.7% and 19.1% respectively, depicting a poor assessment of mortality rate prediction. They thus concluded that POSSUM scoring system required recalibration to allow a better prediction of mortality rates in their study group.

Neary W D [49] conducted a meta-analysis of POSSUM and its modifications using Medline, Cochrane library and Embase databases. A description of the genesis of POSSUM was described, the method of application and analysis, the recommended method and also its limitations with regard to its complexity and inability to predict the individual risk of adverse outcome. A

description of the POSSUM system was given and the results in various studies were described; about missing data and the timing of physiological scoring. The controversies regarding the recommended investigations were also cleared. The lack of facilities to determine accurate measurement of the total blood loss was explained to significantly alter the final score. The applicability of POSSUM in general surgery patients and its evolution for individual specialties was described and studies were reviewed. A comparative analysis of POSSUM and APACHE II was done and the superiority of POSSUM was stressed upon. The authors validated POSSUM as an important comparative surgical audit tool.

Bennet-Guerrero E [(21)] used P-POSSUM to compare mortality rates among surgeries performed in the USA and UK. Prospective analysis of two cohorts in USA (n=1,056) and UK (n=1539) were done. P-POSSUM predicted mortality rates showed significant fit to the observed mortality rates in UK (156 and 152) and in USA (82 and 86). They were able to show a better outcome of surgeries in USA as compared to UK (Odds ratio = 4.5, $p < 0.01$). They thus validated P-POSSUM as a predictor of post operative mortality rates and a valid system in surgical audit to compare outcome among surgical systems in two different countries.

Brooks M S [(50)] compared POSSUM, P-POSSUM score and surgical risk score among 949 patients who underwent general surgical procedures. They observed a significant fit for predicting post operative mortality using P-

POSSUM (observed and expected rates being 7.3 and 8.4 respectively) and surgical risk scoring system (5.9 and 8.4). They concluded by validating both these scoring systems for predicting post operative mortality.

Tambyraja A L [31] evaluated POSSUM in predicting outcome after laparoscopic cholecystectomy in 76 patients aged over 80 years. They found an O: E ratio of 1 for morbidity and 0 for mortality. They concluded by approving POSSUM and suggested correction for predicting mortality following other laparoscopic procedures.

Mohil R S [33] studied POSSUM and P-POSSUM scoring for predicting the adverse outcome rate in patients undergoing emergency laparotomy. 120 patients undergoing emergency laparotomy at Safdarjang Hospital, Delhi, were studied prospectively to assess the applicability in their setup. All patients were scored physiologically pre-operatively and then intra-operative scoring was done, to calculate expected 30 day morbidity and mortality rates. Out of 120 patients, 16 patients (13.3%) died within 30 days of surgery and 62(51.7%) developed significant complications. On analysis, they found an O: E ratio of 0.62 for POSSUM (χ^2 test = 10.79, 9 d. f., p = 0.148) and 0.66 using P-POSSUM (χ^2 = 5.33, 9 d. f., p= 0.619). They concluded that POSSUM and P-POSSUM scoring systems can accurately predict postoperative mortality rates even in the Indian scenario, where patients belonged to the socioeconomic strata with very limited resources. POSSUM and P-POSSUM scoring systems can

also be used to help remove any bias in patient selection and serve as an important method in predicting the post operative adverse outcome.

Parihar V [34] performed a risk adjusted audit of low risk general surgery patients using POSSUM and P-POSSUM in 788 patients. They found a good fit of mortality using POSSUM (O: E ratio = 0.94) and P-POSSUM (O: E ratio = 1.525). In order to reduce over prediction in low risk general surgical patients, they conducted multi variate regression analysis to obtain a new equation called Jabalpur POSSUM (J-POSSUM). It provided a better fit to the observed mortality and morbidity rates (O: E ratio = 1.04) in low risk general surgery patients. They validated POSSUM, P-POSSUM and J-POSSUM scoring system in predicting adverse outcome in general surgery patients in the Indian setup.

Lam C M [51] validated P-POSSUM scoring system among patients who underwent hepatectomy for hepatocellular carcinoma in China for predicting mortality rate. (O: E ratio =1.4 χ^2 test = 7.6, 3 d. f., p=0.055).

Gatt M [52] used POSSUM to randomize two groups of patients who underwent major colonic resection in a randomized controlled trial to evaluate multi modal optimization of surgical care.

METHODOLOGY

SOURCE OF CLINICAL DATA:

The clinical data for this study were obtained from 50 patients undergoing emergency laparotomy for perforative peritonitis admitted in Coimbatore Medical College and Hospital, Coimbatore. Patients were informed about the study and informed consent obtained.

STUDY PERIOD:

The study was conducted during a time frame of 12 months, from December 2012 to November 2013 and the period of follow up was 4 weeks following surgical procedure.

METHOD OF COLLECTING DATA:

Patients admitted in Department of Surgery and scheduled to undergo emergency laparotomy were selected based on inclusion and exclusion criteria and scored according to their physiological and operative findings using a proforma sheet (Annexure). Additional 2 factors were taken into consideration. They are:

1. Perforation – Operation time, i.e. the time duration between the occurrence of perforation and the operation being conducted for the same.
2. Any co-morbid status like diabetes mellitus, hypertension, chronic liver disease and chronic renal failure.

Inclusion criteria:

1. Age above 12 years.
2. Patients with established peritonitis following hollow viscus perforation.
3. Patients with intra-peritoneal abscess due to hollow viscus perforation.

Exclusion criteria:

1. Age 12 years and below.
2. Patients undergoing emergency explorative laparotomy due to other causes like abdominal trauma.
3. Patients with primary peritonitis due to tuberculosis alcoholic cirrhosis, nephrotic syndrome, cardiac failure or systemic lupus erythematosus.

The study protocol was approved by the College Ethical Committee members.

Scores were allotted to the physiological and operative factors in the study and the final expected mortality and morbidity rate was calculated. Complications were assessed by clinical observation. Routine bacteriological screening and postoperative radiological scanning were not carried out, but confirmatory bacteriological and radiological tests were done when clinical suspicion existed.

Physiological scoring:

	SCORES			
	1	2	4	8
Age (in years)	≤ 60	61 – 70	≥ 71	-
Cardiac signs Chest radiograph	No failure	Diuretic, digoxin, antianginal or hypertensive therapy	Peripheral edema; warfarin therapy Borderline cardiomegaly	Raised jugular venous pressure Cardiomegaly
Respiratory history Chest radiograph	No dyspnea	Dyspnea on exertion Mild COAD	Limiting dyspnea (one flight) Moderate COAD	Dyspnea at rest (rate ≥ 30/min) Fibrosis or consolidation
Blood pressure systolic (mmHg)	110 – 130	131 – 170 100 – 109	≥ 171 90 – 99	≤ 89
Pulse (beats/min)	50 – 80	81 – 100	101 – 120	≥ 121
Glasgow coma score	15	12 – 14	9 – 11	≤ 8
Hemoglobin (gm/100ml)	13 – 16	11.5 – 12.9 16.1 – 17.0	10.0 – 11.4 17.1 – 18.0	≤ 9.9 ≥ 18.1
White cell count (x 10^{12} / l)	4 – 10	10.1 – 20.0	≥ 20.1	-
Urea (mmol/L)	≤ 7.5	7.6 – 10.0	10.1 – 15.0	≥ 15.1
Sodium (mmol/L)	≥ 136	131 – 135	126 – 130	≤ 125
Potassium (mmol/L)	3.5 – 5.0	3.2 – 3.4 5.1 – 5.3	2.9 – 3.1 5.4 – 5.9	≤ 2.8 ≥ 6.0
Electrocardiogram	Normal	-	Atrial fibrillation Rate (60-90/min)	Any other abnormal rhythm or ≥ 5 ectopic/min, Q waves or ST/T wave changes

COAD: Chronic Obstructive Airway Disease

Operative scoring:

	Score			
	1	2	4	8
Operative severity*	Minor	Moderate	Major	Major +
Multiple procedures	1	-	2	> 2
Total blood loss (ml)	≤ 100	101 – 500	501 – 999	≥ 1000
Peritoneal soiling	None	Minimal (serous fluid)	Local pus	Bowel content, pus or blood
Presence of malignancy	None	Primary only	Nodal metastases	Distant metastases
Mode of surgery	Elective	-	Emergency resuscitation of >2 hours possible # Operation < 24 hours after admission	Emergency (immediate surgery < 2 hours needed)

# indicates that resuscitation is possible even if this period is not actually utilized.

Surgery of moderate severity includes appendicectomy, cholecystectomy, mastectomy, transurethral resection of prostate.

Major surgery includes any laparotomy, bowel resection, cholecystectomy with choledochotomy, peripheral vascular procedure or major amputation.

Major + surgery include any aortic procedure, abdomino-perineal resection, pancreatic or liver resection, oesophago-gastrectomy.

Physiological score (12-48), Operative score (6-48)

POSSUM equation for morbidity:

Ln R/1- R = - 5.91 + (0.16 x physiological score) + (0.19 x operative severity score)

POSSUM equation for mortality:

Ln R/1 -R= -7.04+ (0.13 x physiological score) + (0.16 x operative severity score)

Where R = predicted risk [4]

The patients were then followed up for a period of 4 weeks post operatively and complications were noted upon the criteria as defined by POSSUM scoring system [4].

Definitions of complications:

Anastomotic Leak	A discharge of the bowel content via the drain, wound or abnormal orifice.
Cardiac Failure	Symptoms or signs of left ventricular or congestive Cardiac failure which required an alteration from preoperative therapeutic measures.
Hemorrhage - Deep	Postoperative bleeding requiring re-exploration.
Hemorrhage - Wound	Local hematoma requiring evacuation.
Infection - Deep	The presence of an intra-abdominal collection confirmed clinically or radiologically.

Infection - Urinary	The presence of bacteria greater than 10^5 / ml and the presence of white cells in the urine, in previously clear urine.
Infection - Wound	Wound cellulitis or the discharge of purulent exudates.
Septicemia	Positive blood culture.
Pyrexia of unknown origin	Any temperature above 37°C for more than 24 h occurring after the original pyrexia following surgery (if present) had settled, for which no obvious cause could be found.
Renal function impaired	Arbitrarily defined as an increase in blood urea of > 5 mmol/l from preoperative levels.
Respiratory failure	Respiratory difficulty requiring emergency ventilation.
Deep venous thrombosis and pulmonary embolus	When suspected confirmation should be obtained by venography or ventilation/perfusion scanning. Alternative is to diagnose at post mortem.
Wound dehiscence	A superficial or deep wound breakdown.

Statistical methods:

Using outcome (dead / alive or complicated / uncomplicated) as a dichotomous dependent comparison between predicted and observed rates of morbidity and mortality was assessed using χ^2 test and statistical significance was determined. The differences in quantitative variables between groups were assessed by means of the unpaired t test. A p value of < 0.05 using a two-tailed test was taken as being of significance for all statistical tests. Logistic Regression analysis was used to assess the mortality & morbidity variables.

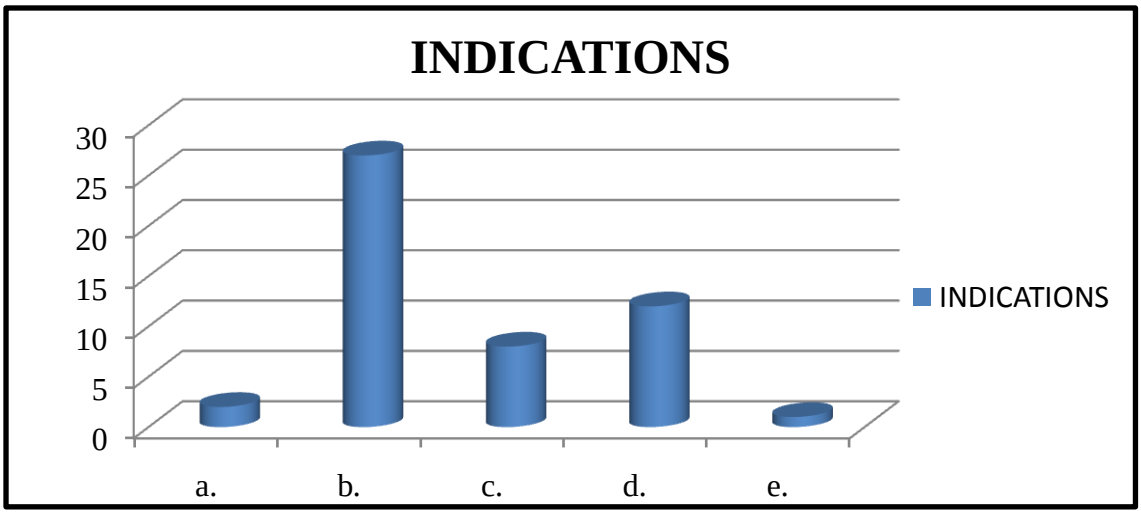
RESULTS

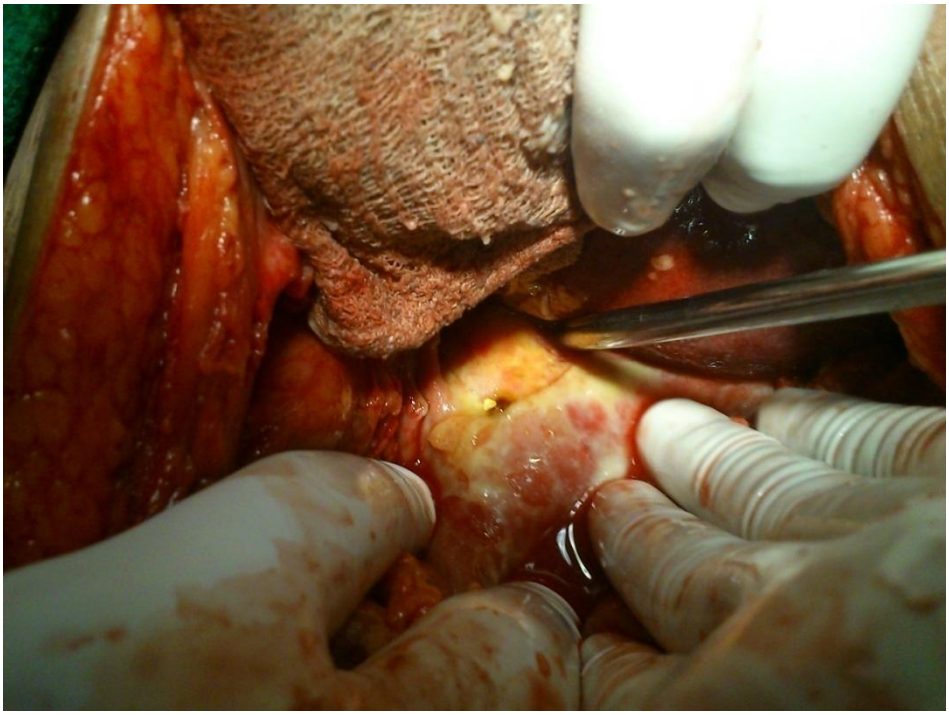
Our study included 50 perforative peritonitis patients operated between December 2012 and November 2013. 39 major surgeries and 11 moderate surgeries were performed as per operative factors, all as emergency procedures.

Table 1: Indications

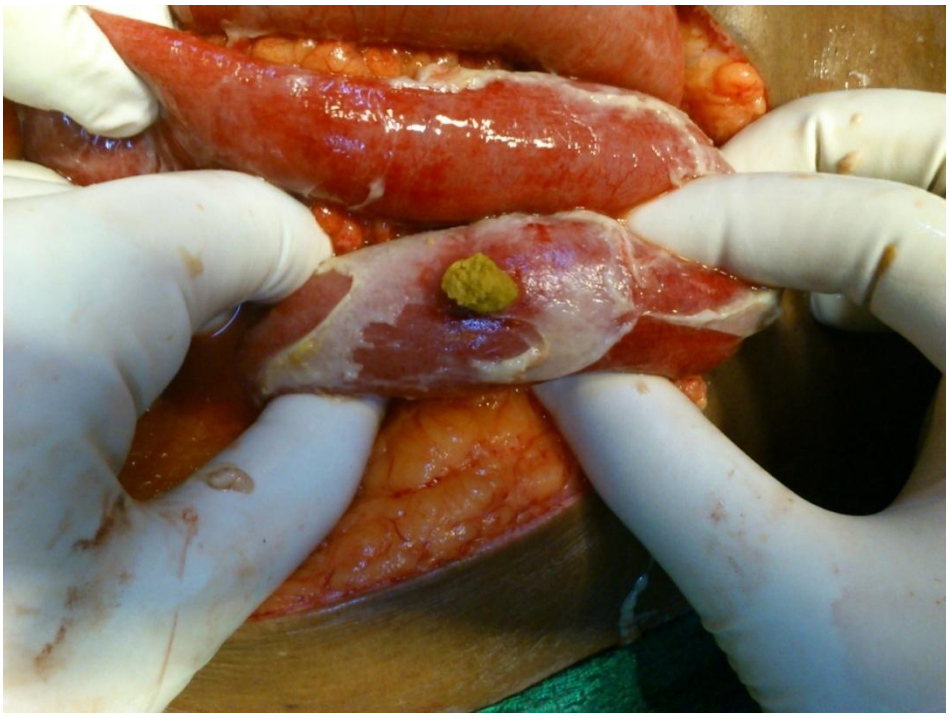
	Indications	No. of patients
a.	Gastric malignancy perforation	2
b.	Duodenal and antral perforation	27
c.	Ileal perforation	8
d.	Appendicular perforation	12
e.	Sigmoid volvulus perforation	1
	Total	**50**

Graph 1: Indications

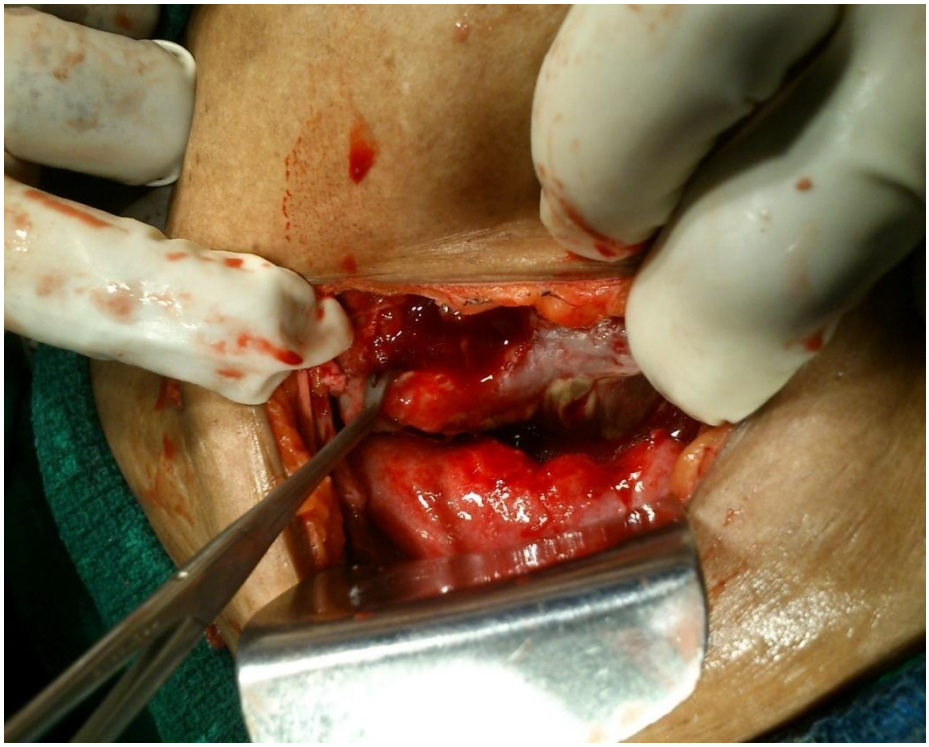




PHOTOGRPH 1: PERFORATED DUODENAL ULCER



PHOTOGRAPH 2: ILEAL PERFORATION



PHOTOGRAPH 3: PERFORATED APPENDICITIS WITH ABSCESS

PHOTOGRAPH 4: PERFORATED APPENDIX WITH FECOLITH

PHOTOGRAPH 5: GANGRENOUS SIGMOID VOLVULUS WITH PERFORATION

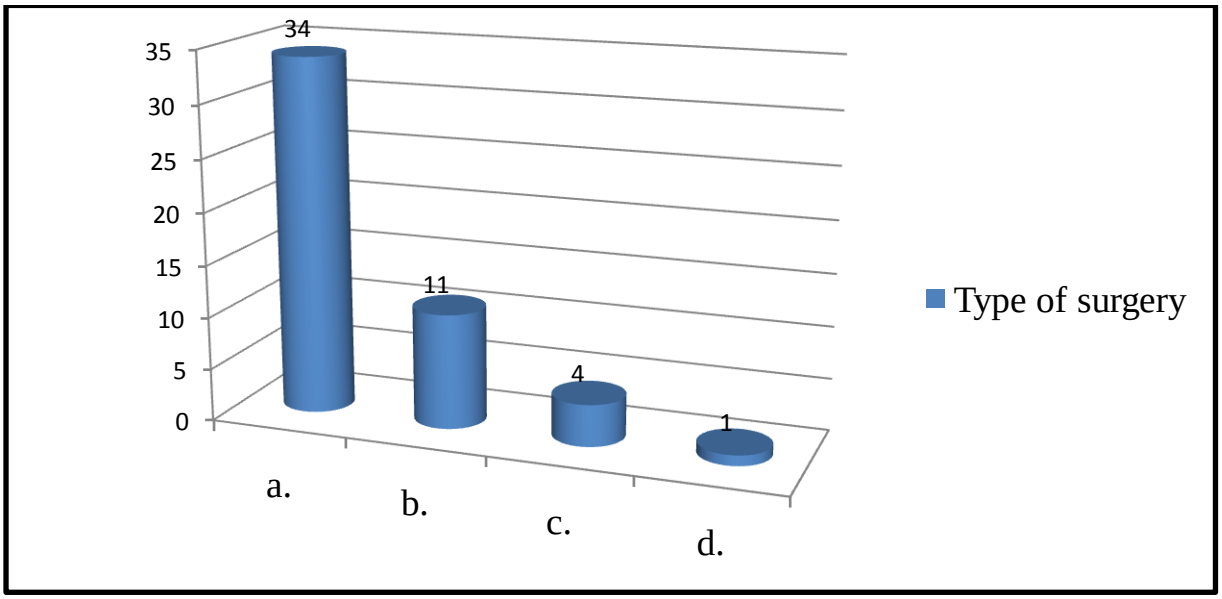
Types of surgeries performed:

39 major surgeries performed were perforation closure, resection anastomosis, colostomy, ileostomy and feeding jejunostomy and 11 moderate procedures include appendicectomy.

Table 2: Types of surgeries

	Type of Surgery	No. of patients
a.	Perforation closure with omental patch	34
b.	Appendicectomy	11
c.	Resection anastomosis	4
d.	Stoma	1
	Total	**50**

Graph 2: Types of surgeries

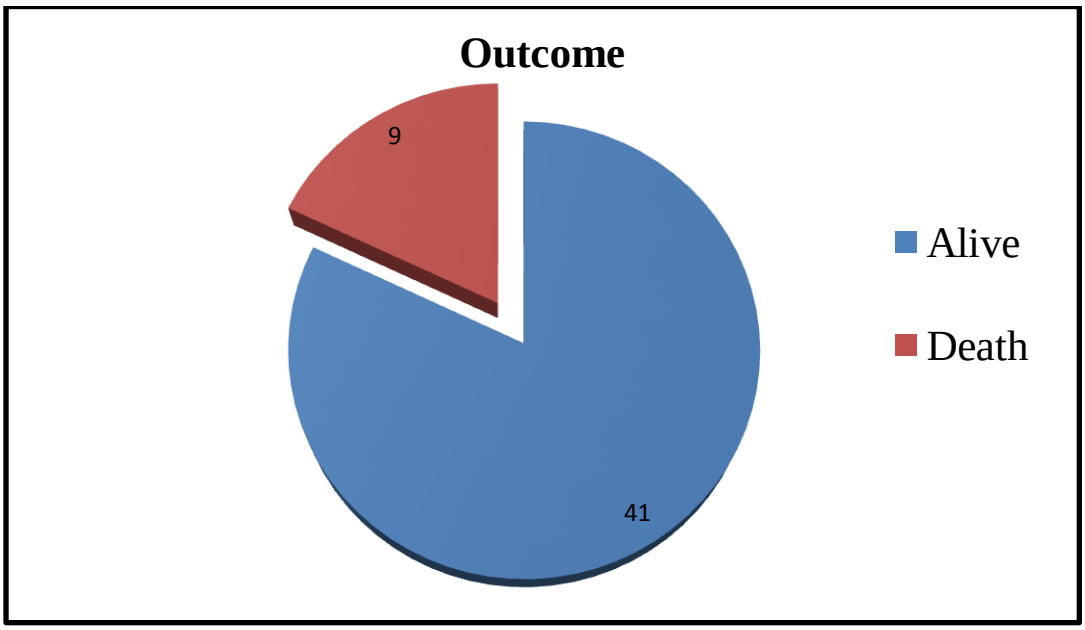


Outcome of surgery:

Out of 50 patients studied, death occurred in 9 patients resulting in crude mortality rate of 18% represented in graph 3.

Out of the remaining 41 patients, 25 patients had at least one complication, resulting in crude morbidity rate of 61%. The remaining 16 patients showed no evidence of any complication.

Graph 3: Outcome of surgery



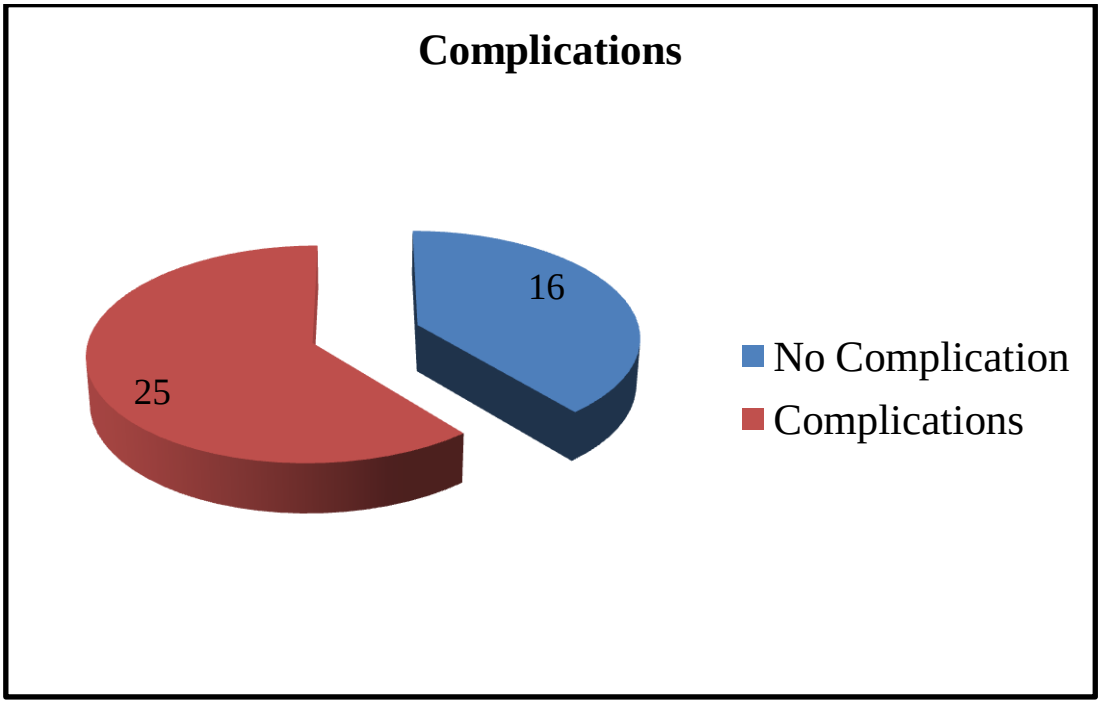
Complications:

The complications during the 4 weeks follow up period were as follows in Table 3.

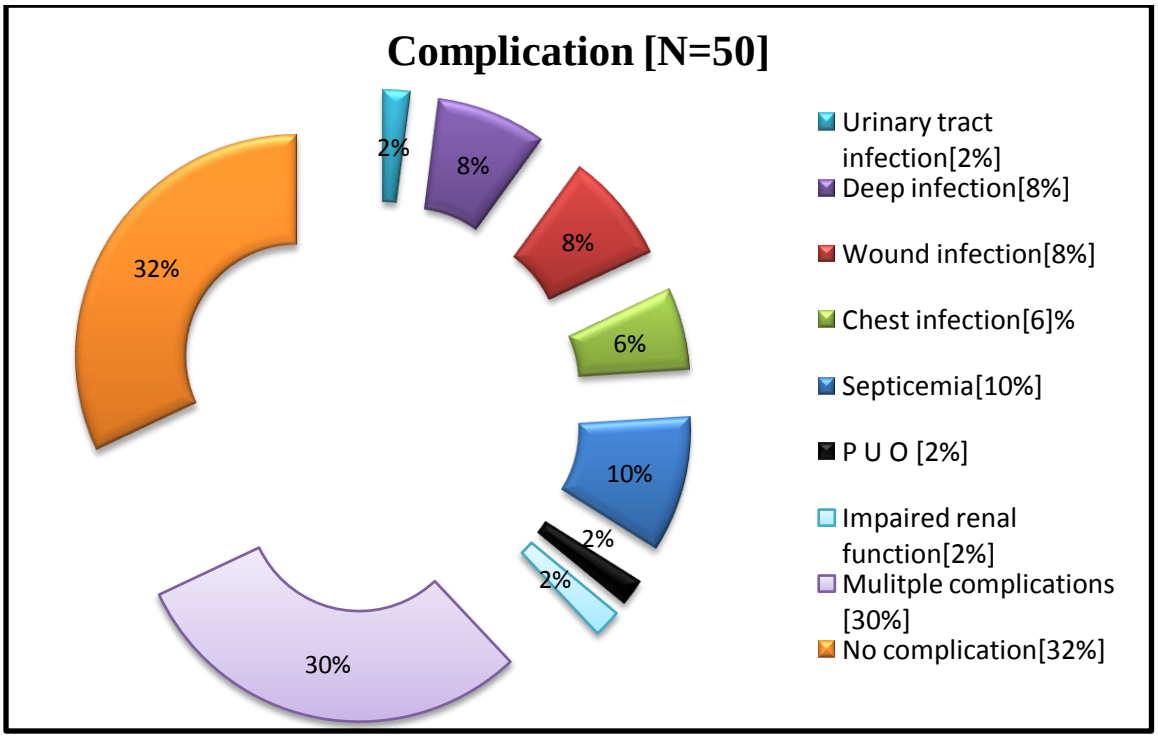
Table 3: List of complications

Complication	**[n]**
Urinary tract infection	1
Deep infection	4
Wound infection	4
Chest infection	3
Septicemia	5
Pyrexia of unknown origin	1
Impaired renal function	1
Multiple complications	15
No complication	16
Total	**50**

Graph 4: Complications



Graph 5: Individual complications



Observed: Expected mortality rates:

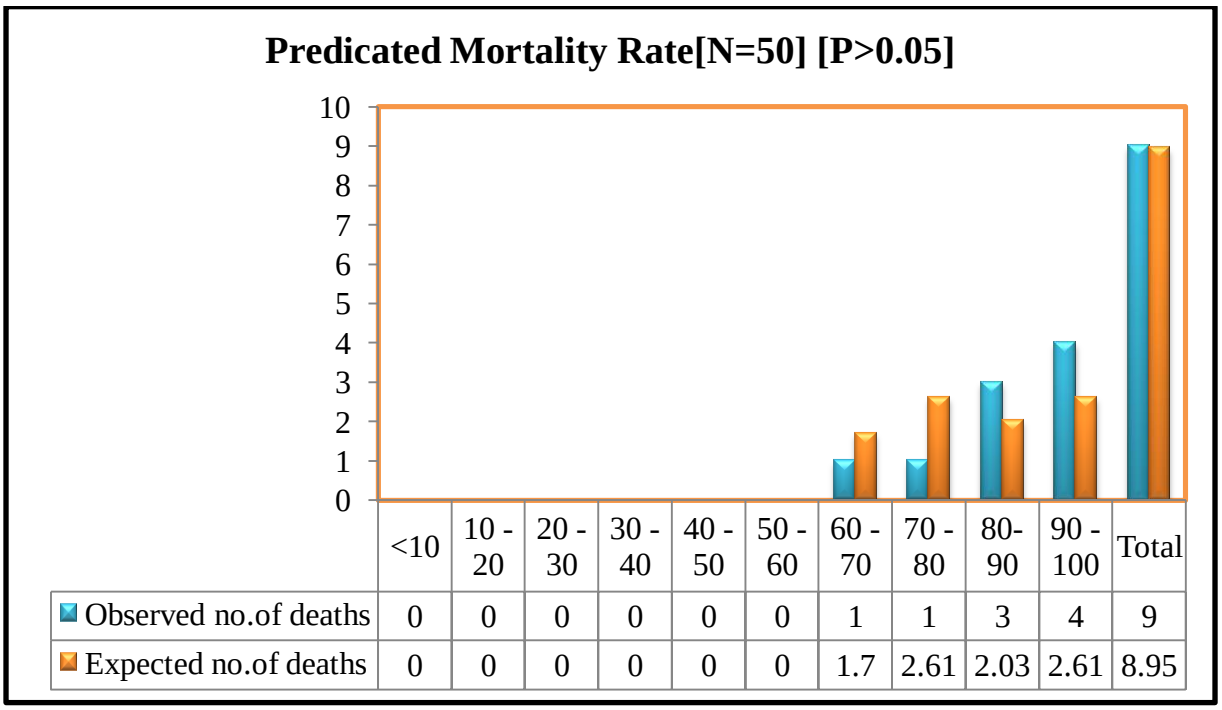
Comparison of observed and POSSUM predicted mortality rates was done using linear analysis is represented in table 4 and graph 6.

An observed to expected ratio (O: E) of 1.005 was obtained and there was no significant difference between the predicted and observed values (χ^2 = 3.54, p = 0.316).

Table 4: O: E mortality rate

Predicated	No. of	Observed no.	Expected no.
<10	4	0	0
10 -20	7	0	0
20 -30	4	0	0
30 -40	8	0	0
40 -50	4	0	0
50 - 60	1	0	0
60 -70	5	1	1.7
70 -80	8	1	2.61
80-90	4	3	2.03
90 -100	5	4	2.61
Total	**50**	**9**	**8.95**

Graph 6: O: E ratio



	<10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80- 90	90 - 100	Total
Observed no.of deaths	0	0	0	0	0	0	1	1	3	4	9
Expected no.of deaths	0	0	0	0	0	0	1.7	2.61	2.03	2.61	8.95

Observed: Expected morbidity rates

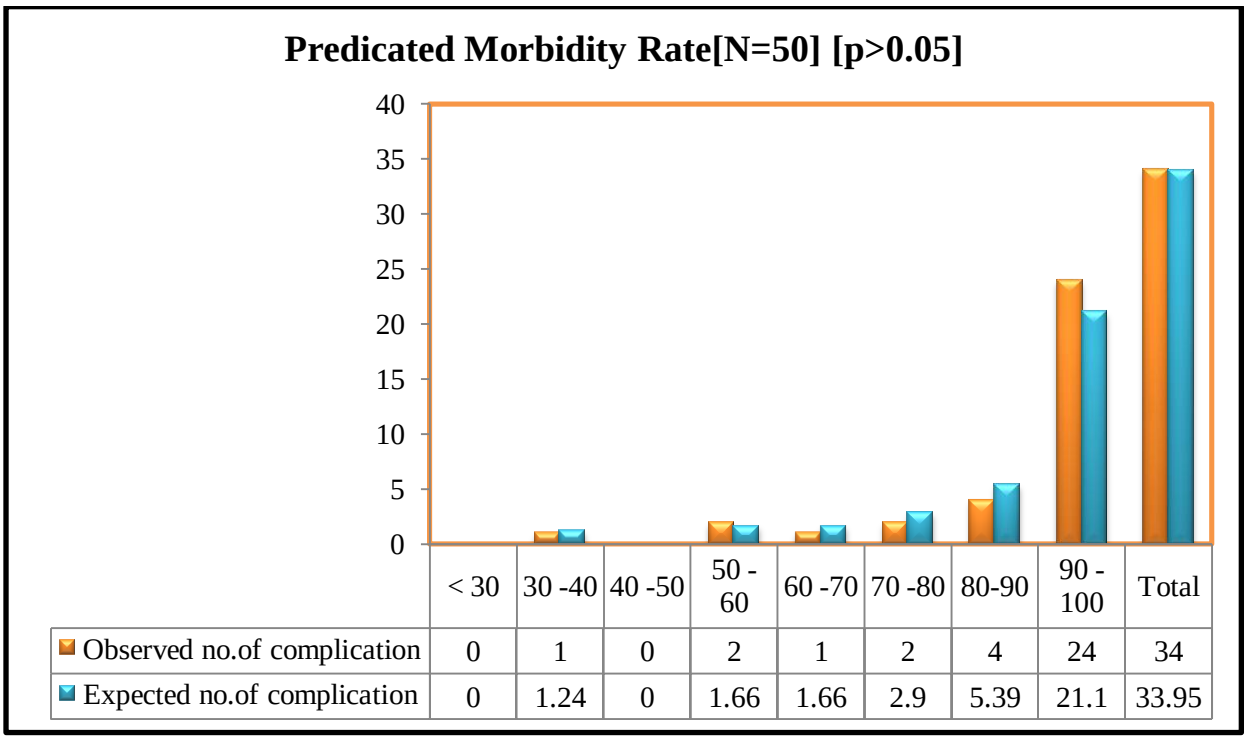
Comparison of observed and POSSUM predicted morbidity rates was done using linear analysis is represented in table 5 and graph 7.

An observed to expected ratio (O: E) of 1.001 was obtained and there was no significant difference between the predicted and observed values ($\chi^2 = 2.40$, $p = 0.792$).

Table 5: O: E for morbidity rate

Predicated	No. of	Observed no. of	Expected no. of
< 30	2	0	0
30 -40	2	1	1.24
40 -50	0	0	0
50 - 60	2	2	1.66
60 -70	3	1	1.66
70 -80	5	2	2.9
80-90	9	4	5.39
90 -100	27	24	21.1
Total	**50**	**34**	**33.95**

Graph 7: O: E for morbidity rate



	< 30	30 -40	40 -50	50 - 60	60 -70	70 -80	80-90	90 - 100	Total
Observed no.of complication	0	1	0	2	1	2	4	24	34
Expected no.of complication	0	1.24	0	1.66	1.66	2.9	5.39	21.1	33.95

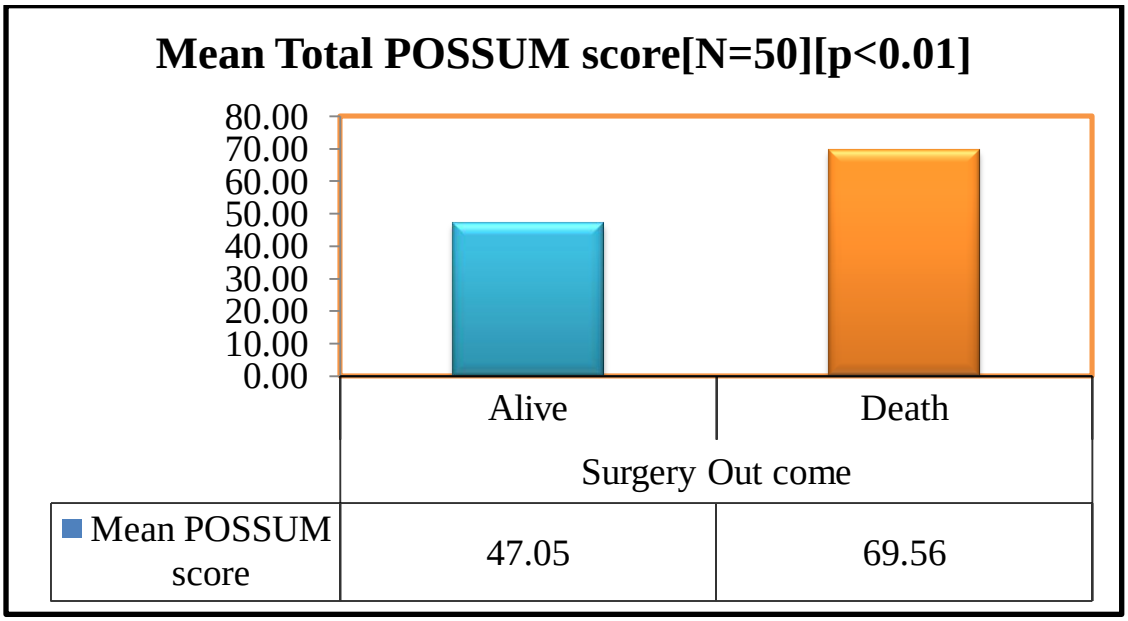
Mean total POSSUM score vs Outcome:

The mean POSSUM score in our study was 51.1. The mean POSSUM score of patients who survived was 47.05 and those with mortality was 69.56. ($p < 0.01$; Statistically significant)

Table 6: Mean POSSUM vs Outcome

Group	No. Of patients	Mean total POSSUM score
Alive	41	47.05
Death	9	69.56
Total	50	51.10

Graph 8: Mean POSSUM vs Outcome



RISK FACTORS

The analysis of risk factors for mortality in our study is shown in table 7.

Table 7: Risk factors

Sr. No.	Risk factors	p value	Inference
1	Age	>0.05	Not significant
2	Cardiovascular system	>0.05	Not significant
3	Respiratory system	<0.05	**Significant**
4	Blood pressure	<0.05	**Significant**
5	Pulse rate	>0.05	Not significant
6	Glasgow coma scale	<0.01	**Significant**
7	Hemoglobin	>0.05	Not significant
8	White cell count	>0.05	Not significant
9	Blood urea	>0.05	Not significant
10	Sodium	<0.05	**Significant**
11	Potassium	<0.01	**Significant**
12	ECG	>0.05	Not significant
13	Operative Complexity	>0.05	Not significant
14	Multiple procedures	<0.01	**Significant**
15	Total blood loss	<0.05	**Significant**
16	Peritoneal contamination	>0.05	Not significant

17	Malignancy	<0.05	**Significant**
18	Mode of Surgery	<0.05	**Significant**
	P – O Time	<0.05	**Significant**
	Co-morbidities	<0.05	**Significant**

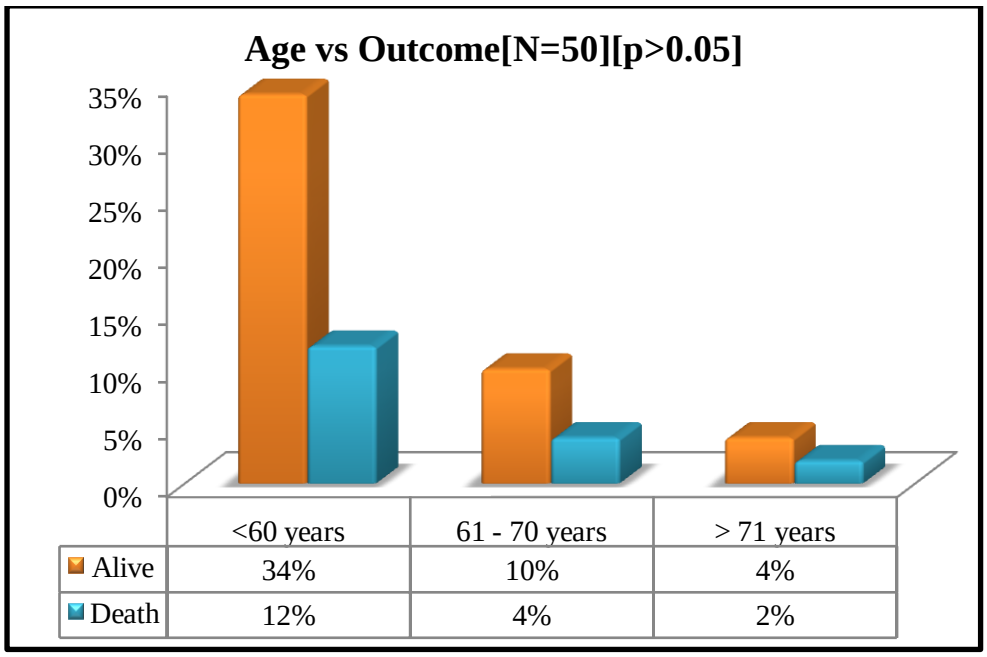
1. Age

Out of 50 patients operated, 40 patients were below 60 years (6 deaths; 12%), 7 patients between 61 – 70 years (2 deaths; 4%) and 3 patients above 71 years (1 death; 2%). ($p > 0.05$; statistically not significant)

Table 8: Age vs. Outcome

AGE vs. OUTCOME			
AGE	Outcome of Surgery		Total
	Alive	Death	
<60 years	34	6	40
61 - 70 years	5	2	7
> 71 years	2	1	3
Total	41	9	50

Graph 9: Age vs. Outcome



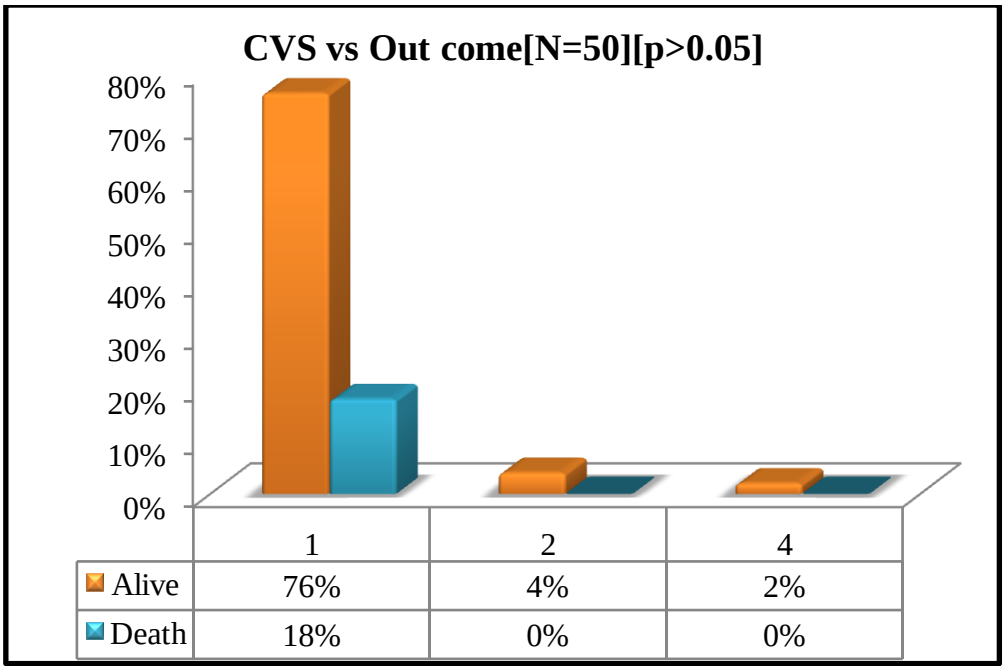
2. Cardiovascular System: (CVS.)

There were only 3 patients operated with higher POSSUM score and none resulted in death. Remaining 47 patients had no cardiac risk, death occurred in 9 patients. ($p > 0.05$; statistically not significant)

Table 9: CVS. vs. Outcome

CVS vs. OUTCOME			
CVS	Outcome of Surgery		Total
	Alive	Death	
If no failure	38	9	47
If diuretic, digoxin, anti-anginal or	2	0	2
If peripheral edema, warfarin	1	0	1
Total	41	9	50

Graph 10: CVS. vs. Outcome



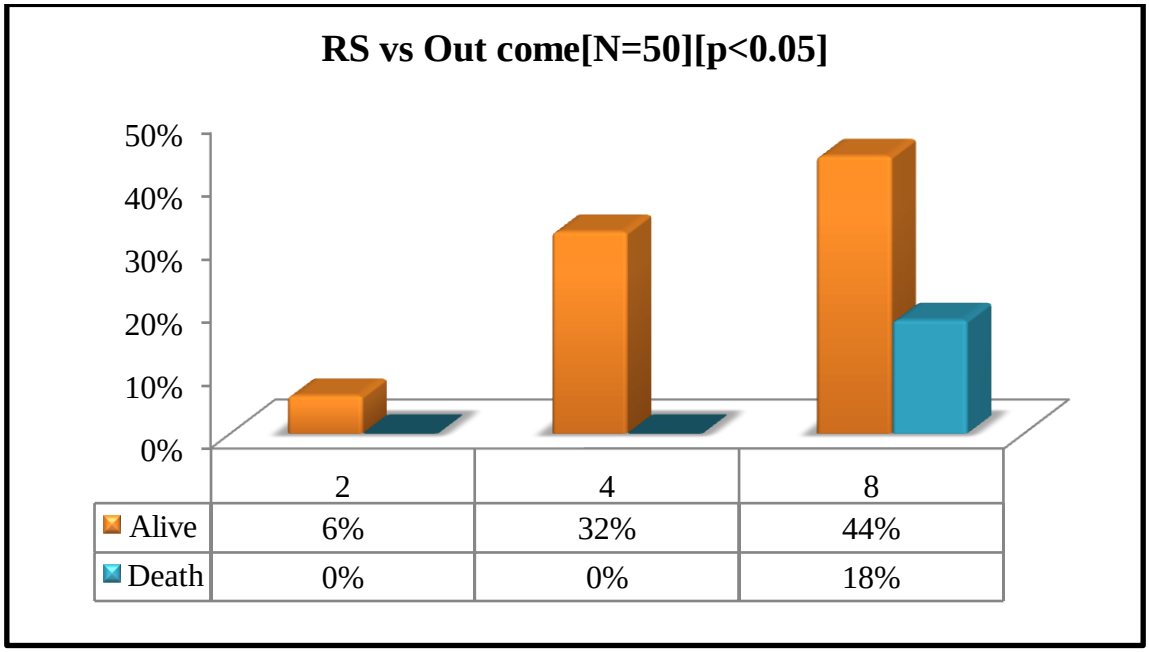
3. **Respiratory system: (RS)**

All patients had some degree of respiratory compromise. Out of the 9 deaths that occurred in our study all had a POSSUM score of 8 on admission, that is they had a respiratory rate more than 30 /min or consolidation on chest X-ray. ($p < 0.05$; statistically significant)

Table 10: RS vs. Outcome

RESPIRATORY SYSTEM vs. OUTCOME			
RS	Outcome of Surgery		Total
	Alive	Death	
2 If dyspnea on exertion	3	0	3
4 If limiting dyspnea (one flight of	16	0	16
8 If dyspnea at rest (≥30/min), fibrosis	22	9	31
Total	41	9	50

Graph 11: RS vs. Outcome



4. **Blood pressure: (BP)**

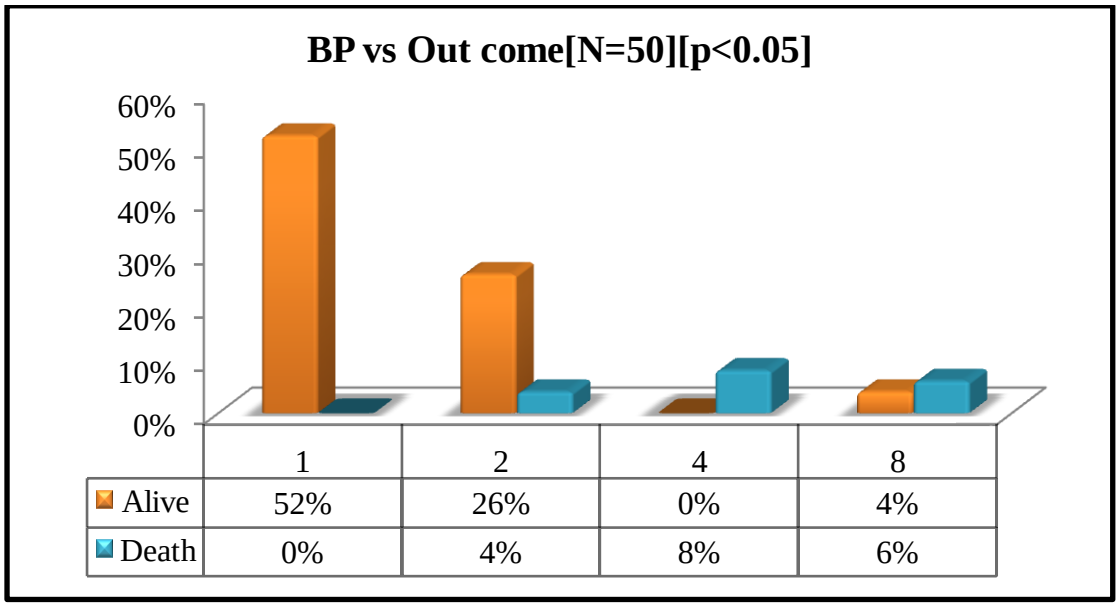
Out of 50 patients, 24 patients (48% cases) had an abnormal systolic pressure. All 9 patients who died had a higher POSSUM score. No mortality was seen in 26 patients with normal blood pressure.

($p < 0.05$; statistically significant)

Table 11: BP vs. Outcome

BLOOD PRESSURE VS. OUTCOME			
BP	Outcome of Surgery		Total
	Alive	Death	
1 if 110-130mm Hg systolic	26	0	26
2 if 131-170mmHg systolic	13	2	15
4 if ≥171, 90-99mmHg systolic	0	4	4
8 if ≤89 mmHg systolic	2	3	5
Total	41	9	50

Graph 12: BP vs. Outcome



5. Pulse rate: (PR)

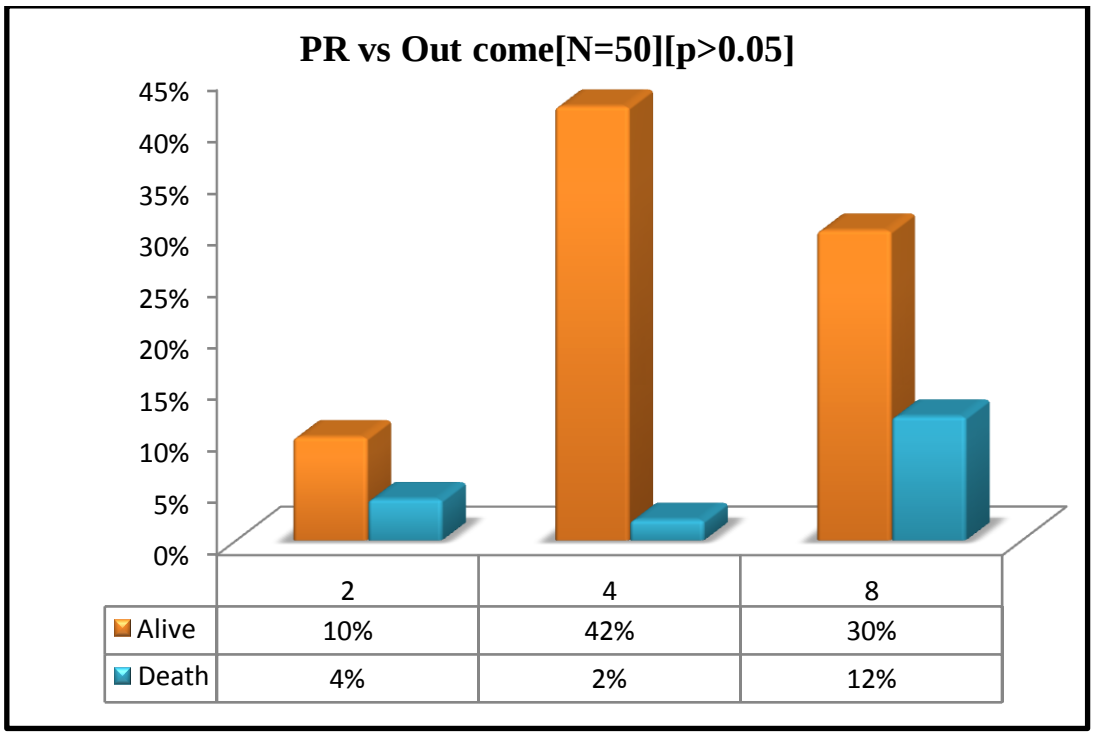
All the patients operated showed abnormal pulse rate (either tachycardia or bradycardia). There was no statistical significance in our study.

($p > 0.05$)

Table 12: PR vs. Outcome

PR vs. OUTCOME			
PR	Outcome of Surgery		Total
	Alive	Death	
2 if 81-100, 40-49 beats/min	5	2	7
4 if 101-120 beats/min	21	1	22
8 if ≥121, ≤39 beats/min	15	6	21
Total	41	9	50

Graph 13: PR vs. Outcome



6. Glasgow coma scale: (GCS)

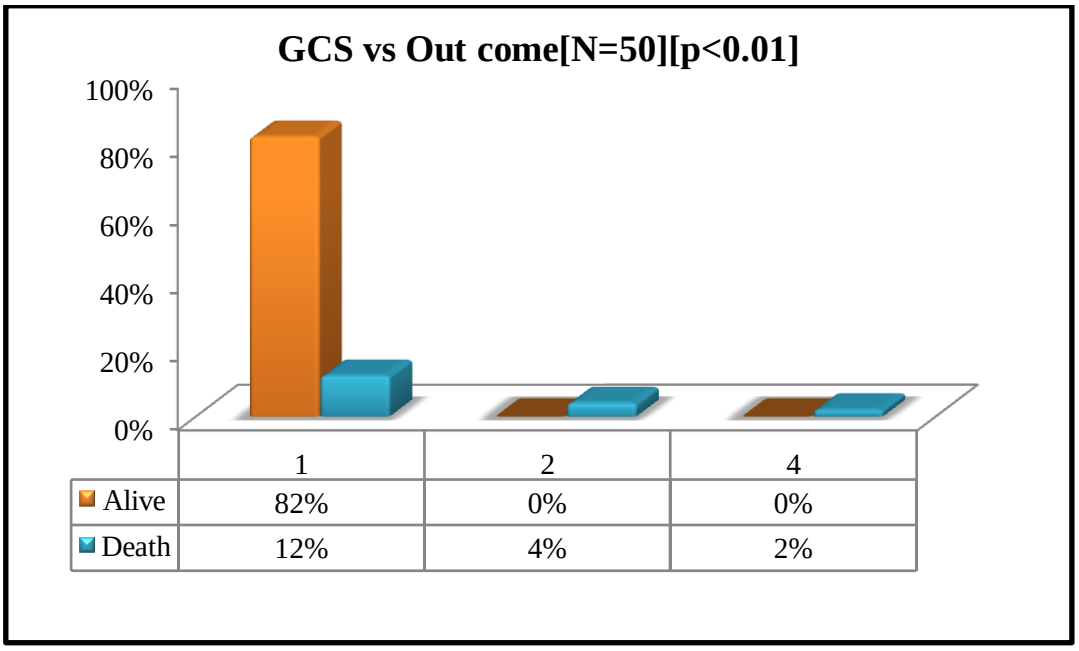
Out of the 9 patients in whom death occurred, 3 patients had a lower GCS and a higher POSSUM score. The remaining 6 patients had normal GCS. All the patients who survived (41 patients) had normal GCS.

($p < 0.01$; statistically significant)

Table 13: GCS vs. Outcome

GCS vs. OUTCOME			
GCS	Outcome of Surgery		Total
	Alive	Death	
1 if scale is 15	41	6	47
2 if scale is 12-14	0	2	2
4 if scale is 9-11	0	1	1
Total	41	9	50

Graph 14: GCS vs. Outcome



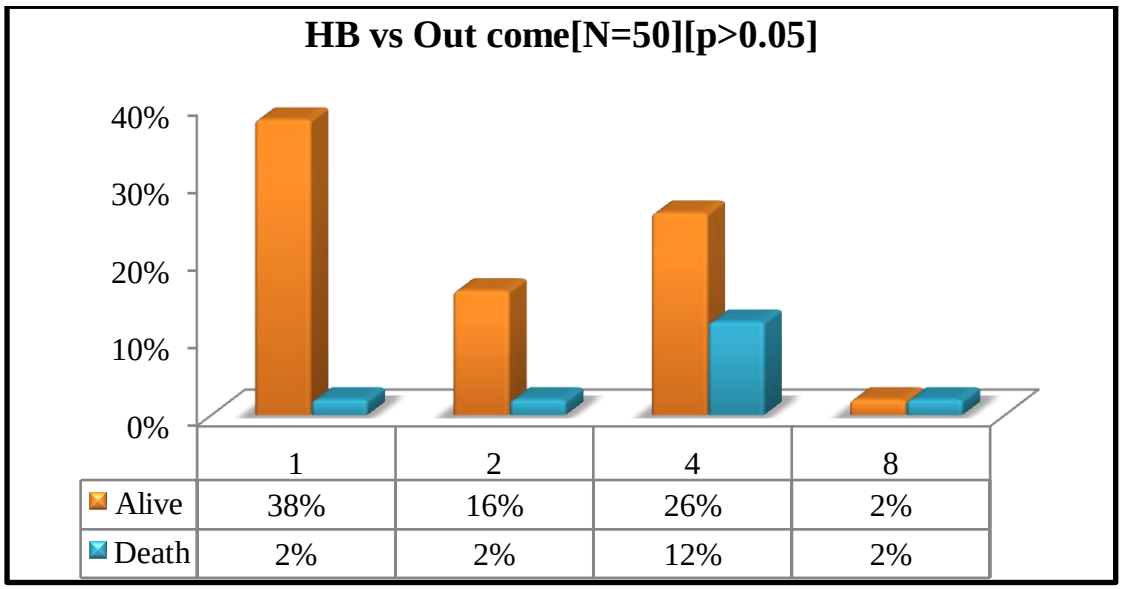
7. Hemoglobin: (HB)

30 patients had abnormal hemoglobin levels. Out of which death occurred in 8 patients (26.6% cases). 1 patient with normal hemoglobin level died (5% cases). ($p > 0.05$; statistically not significant)

Table 14: HB vs. Outcome

HB vs. OUTCOME			
HB	Outcome of Surgery		Total
	Alive	Death	
1 if 13-16 g/dl	19	1	20
2 if 11.5-12.9 or 16.1-17 g/dl	8	1	9
4 if 10-11.4 or 17.1-18 g/dl	13	6	19
8 if ≤9.9 or ≥18.1 g/dl	1	1	2
Total	41	9	50

Graph 15: HB vs. Outcome



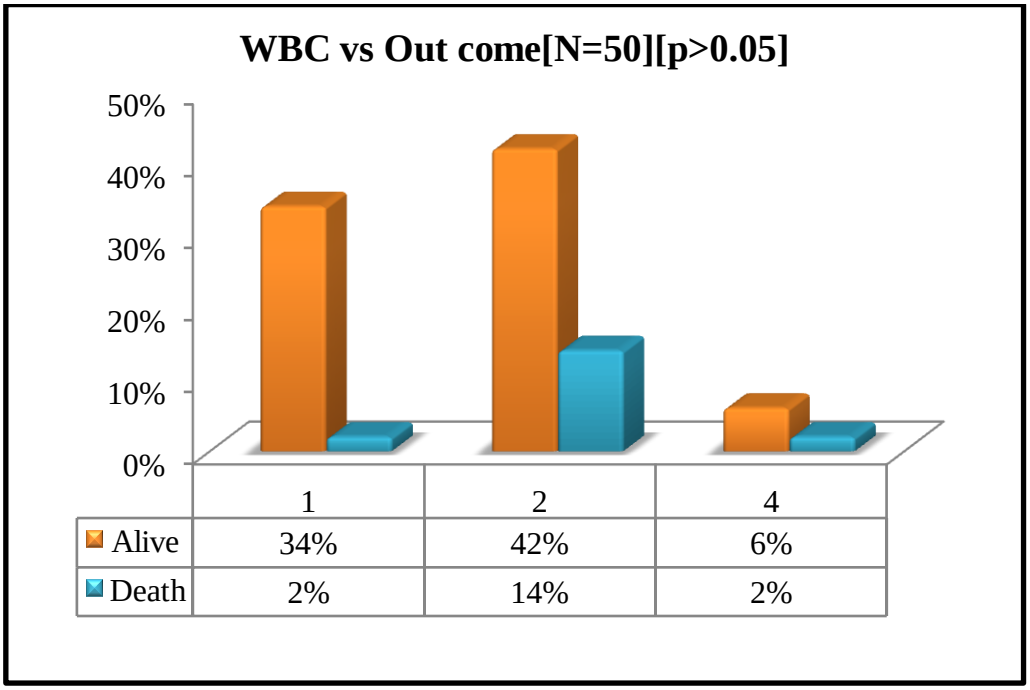
8. White cell count: (WBC)

Out of the 50 cases operated, leucocytosis was seen in 32 cases (64%). Out of the 32 patients, 24 patients (75%) were alive and death occurred in 8 (25%) patients. Out of 18 patients with normal count one patient succumbed. ($p > 0.05$; statistically not significant)

Table 15: WBC vs. Outcome

WBC ($X\ 10^{12}/L$) vs. OUTCOME			
WBC	Outcome of Surgery		Total
	Alive	Death	
1 if 4-10	17	1	18
2 if 10.1-20 or 3.1-4	21	7	28
4 if ≥20.1 or ≤3.1	3	1	4
Total	41	9	50

Graph 16: WBC vs. Outcome



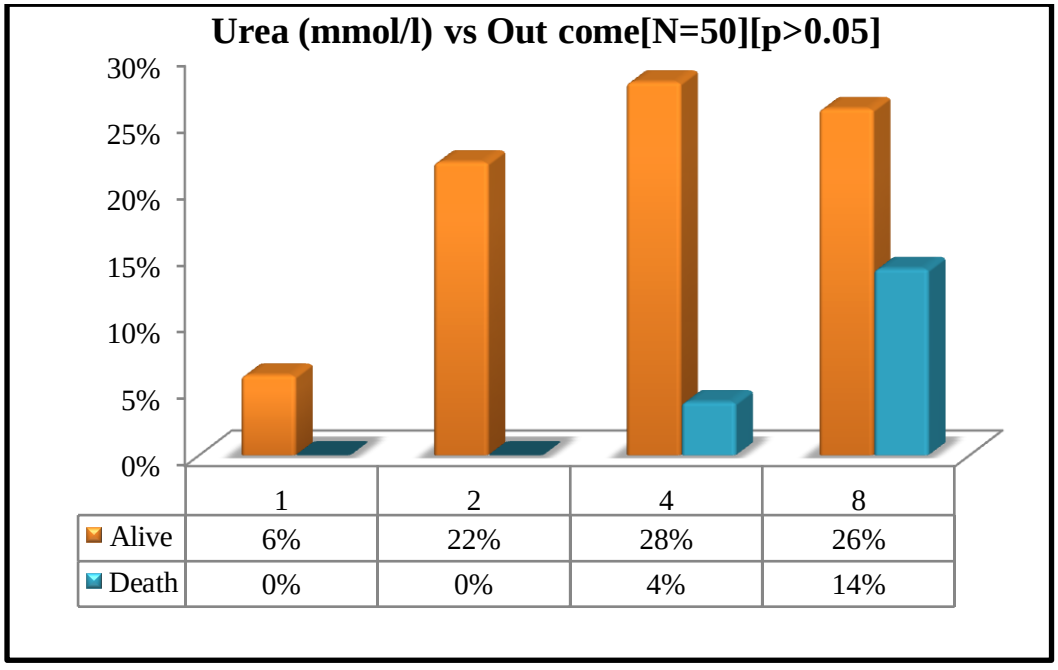
9. Blood urea level: (UREA)

Out of 50 cases, 94% (47 patients) had raised urea levels. Death occurred in 18% (9 patients) and 76% (38 patients) survived. 6% (3 patients) had normal urea level. ($p > 0.05$; statistically not significant)

Table 16: UREA vs. Outcome

UREA (mmol/l) vs. OUTCOME			
UREA	Outcome of Surgery		Total
	Alive	Death	
1 if ≤7.5	3	0	3
2 if 7.6-10	11	0	11
4 if 10.1 15	14	2	16
8 if ≥15.1	13	7	20
Total	41	9	50

Graph 17: Urea vs. Outcome



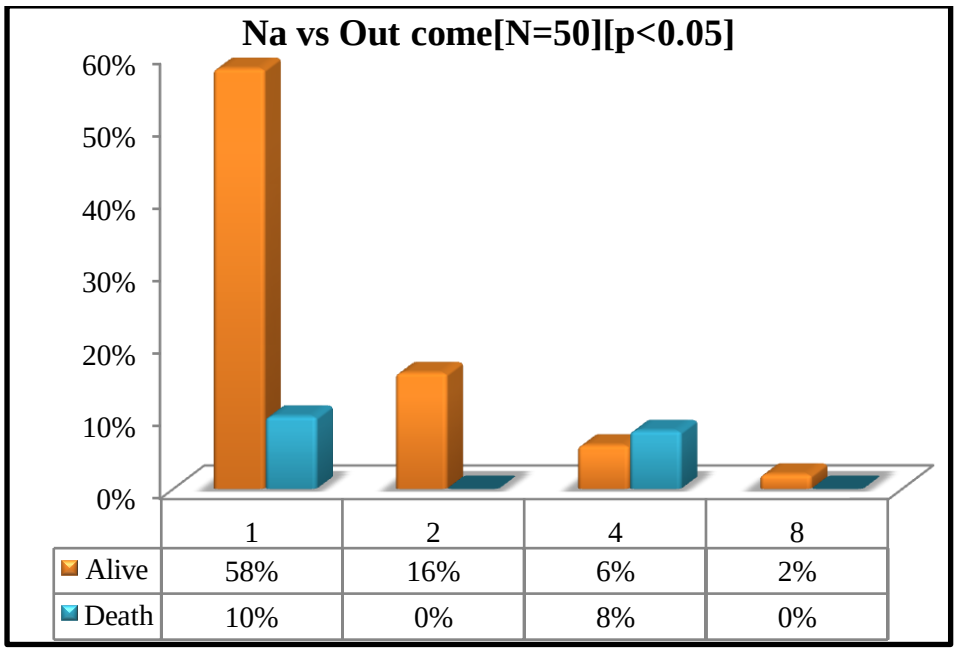
10. Serum sodium: (Na^+)

Surgeries done on cases with serum sodium abnormalities accounted for 16 cases (32% patients) with mortality occurring in 4 cases amongst them (25%). ($p < 0.05$; statistically significant)

Table 17: Na^+ vs. Outcome

Na^+ (mmol/l) vs. OUTCOME			
Na^+	Outcome of Surgery		Total
	Alive	Death	
1 if ≥ 136	29	5	34
2 if 131-150	8	0	8
4 if 126-130	3	4	7
8 if ≤125	1	0	1
Total	41	9	50

Graph 18: Na^+ vs. Outcome



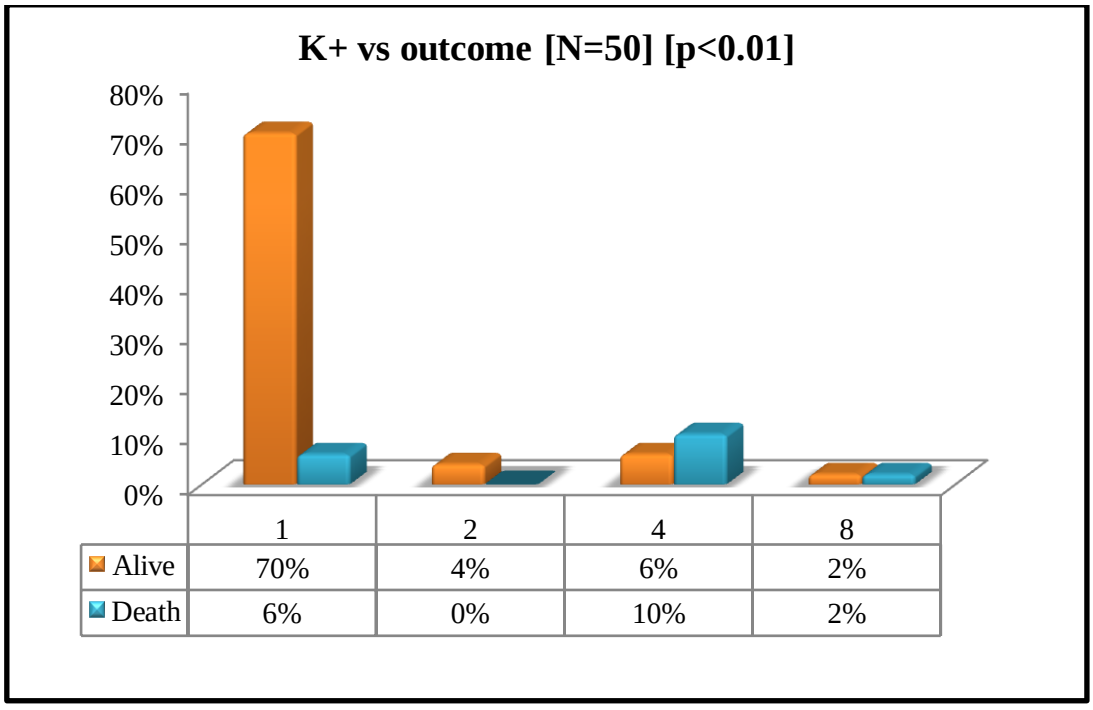
11. Serum Potassium: (K^+)

Our study comprised of 12 patients (24%) with some degree of potassium imbalance which accounted for death in 6 patients (50%). On analyzing the p value ($p < 0.01$), it was found to be statistically significant.

Table 18: K^+ vs. Outcome

K^+ (mmol/l) vs. OUTCOME			
K^+	Outcome of Surgery		Total
	Alive	Death	
1 if 3.5-5.0	35	3	38
2 if 3.2-3.4 or 5.2-5.3	2	0	2
4 if 2.9-3.1 or 5.4-5.9	3	5	8
8 if ≤2.8 or ≥6	1	1	2
Total	41	9	50

Graph 19: K^+ vs. Outcome



12. Electrocardiogram: (ECG)

All 50 patients undergoing surgery did not reveal any abnormality on ECG; hence no statistical analysis could be made.

Table 19: ECG vs Outcome

ECG vs Outcome			
Electrocardiogram	Outcome of Surgery		Total
	Alive	Death	
1 if normal	41	9	50
4 if Atrial fibrillation (rate 60-90)	0	0	0
8 if any other abnormal rhythm or >5 ectopics/min, Q waves or ST/T wave changes	0	0	0
Total	41	9	50

OPERATIVE FACTORS

1. Operative Complexity: (OC)

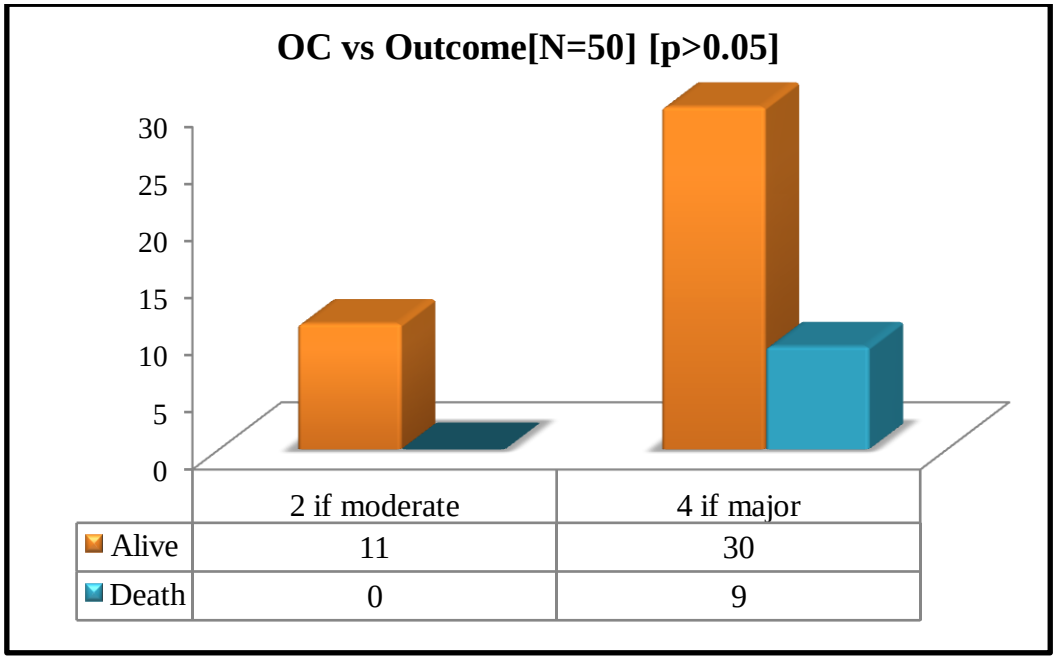
Out of 50 surgeries performed, 39 were major surgeries and 11 were of moderate complexity. All the 9 deaths occurred in major surgeries.

($p > 0.05$; statistically not significant)

Table 20: OC vs. Outcome

OC vs. OUTCOME			
OC	Outcome of Surgery		Total
	Alive	Death	
2 if moderate	11	0	11
4 if major	30	9	39
Total	41	9	50

Graph 20: OC vs. Outcome



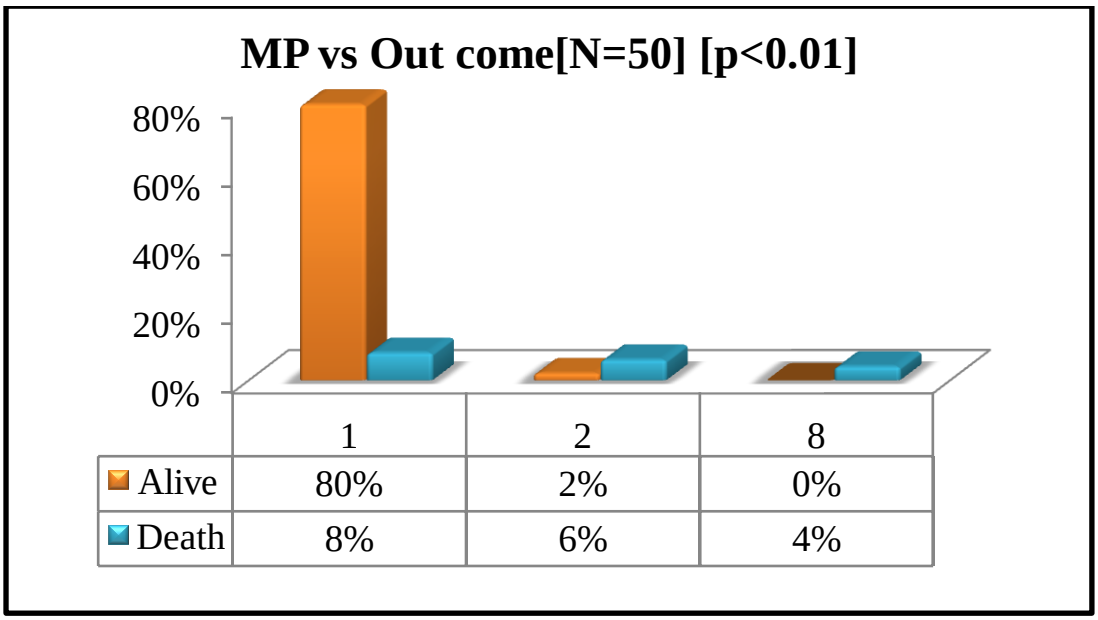
2. **<u>Multiple procedures:</u> (MP)**

Out of 50 patients, single procedure was performed on 44 patients (88%) out which mortality occurred in 4 patients (9%), whereas multiple procedures were performed on 6 patients (12%) out which mortality occurred in 5 patients (83.3%). ($p < 0.01$; statistically significant)

<u>Table 21: MP vs. Outcome</u>

MP vs. OUTCOME			
MP	Outcome of Surgery		Total
	Alive	Death	
1 if single procedure	40	4	44
2 if 2 procedures	1	3	4
8 if >2 procedures	0	2	2
Total	41	9	50

<u>Graph 21: MP vs. Outcome</u>



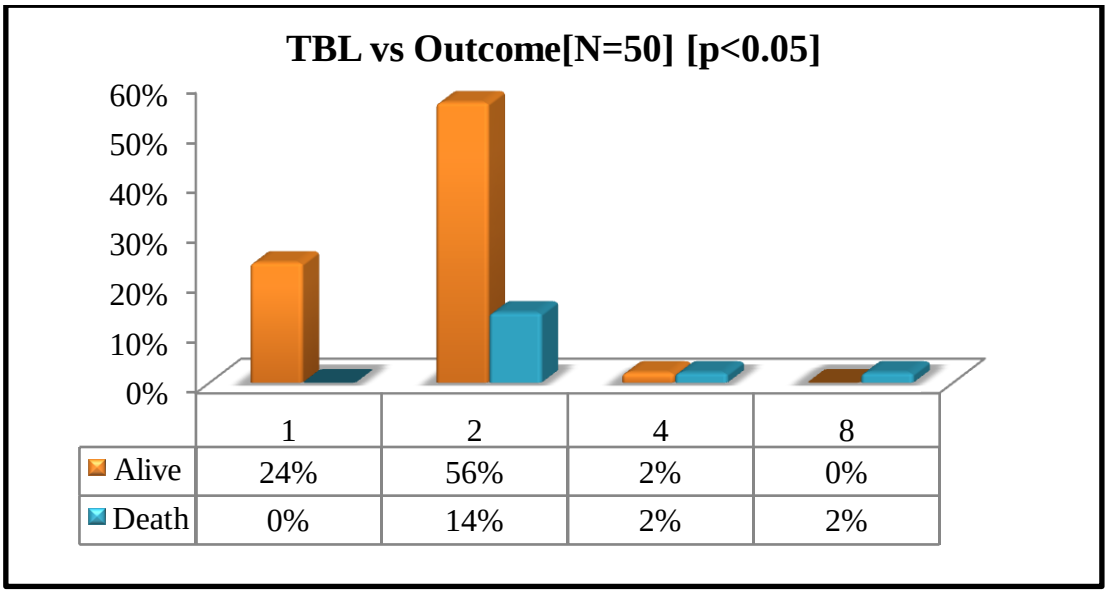
3. Total blood loss (TBL)

In our study we found 35 patients (70% cases) resulted in 100 – 500ml blood loss with mortality in 7 patients (20% cases). 1 out of 2 patients died in 501 – 1000 ml group and 1 death occurred in >1000ml group. ($p < 0.05$; statistically significant)

Table 22: TBL vs. Outcome

TBL (ml) vs. OUTCOME			
TBL	Outcome of Surgery		Total
	Alive	Death	
1 if <100	12	0	12
2 if 100-500	28	7	35
4 if 501-999	1	1	2
8 if ≥ 1000	0	1	1
Total	41	9	50

Graph 22: TBL vs. Outcome



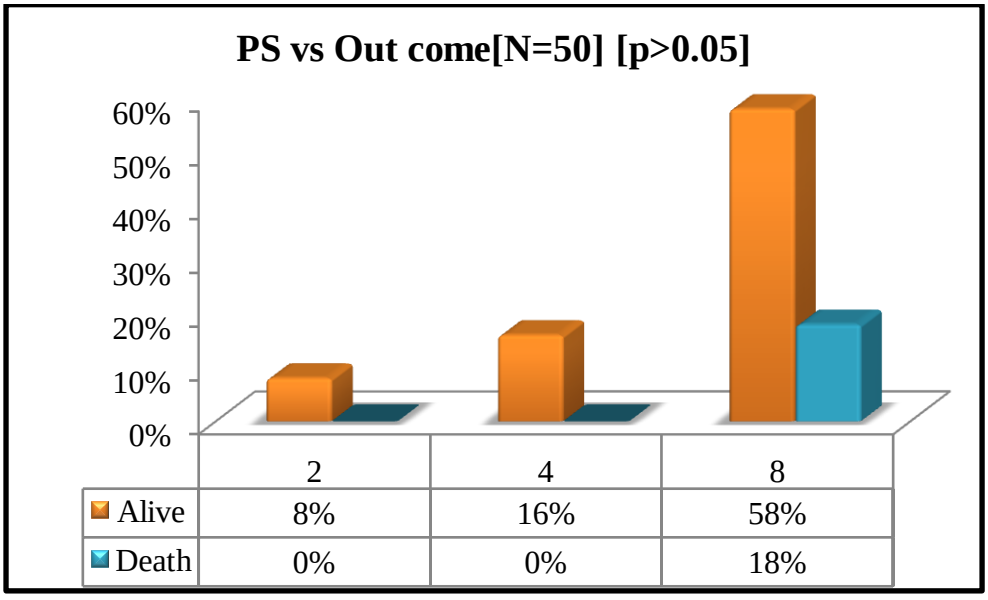
4. Peritoneal Soiling (PS)

In our study 38 patients (76%) had gross peritoneal contamination with bowel contents. In 8 patients (16%) localized pus was present and in 4 patients (8%) minimal serous peritoneal fluid was found. Death occurred in 9 patients (18%) all of whom had bowel contents in the peritoneal cavity. ($p > 0.05$; statistically not significant)

Table 23: PS vs. Outcome

PS vs. OUTCOME			
PS	Outcome of Surgery		Total
	Alive	Death	
2 if minimal (serous fluid)	4	0	4
4 if local pus	8	0	8
8 if bowel contents, pus or blood	29	9	38
Total	41	9	50

Graph 23: PS vs. Outcome



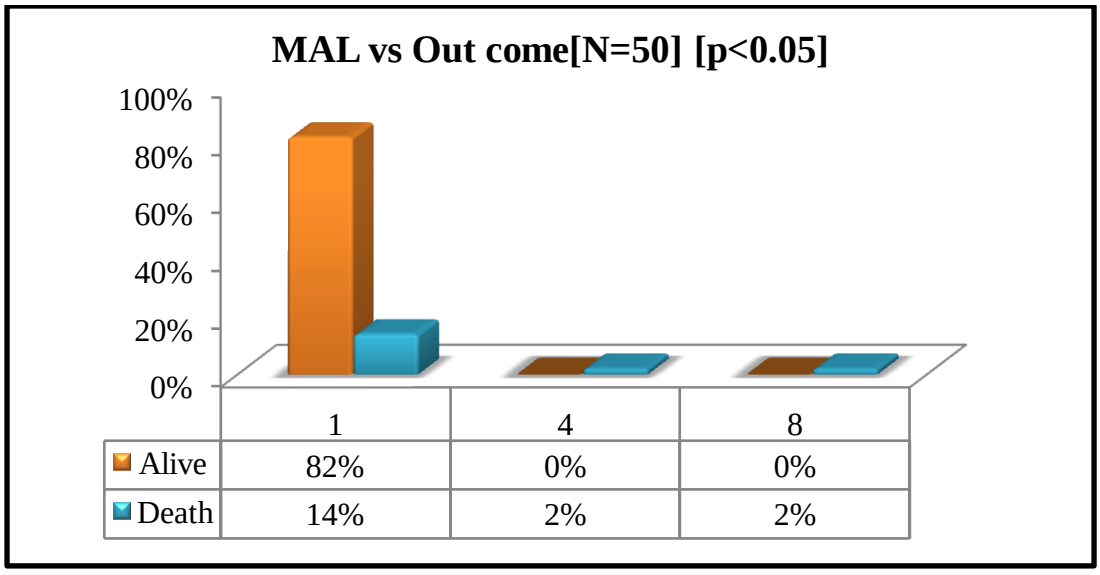
5. Presence of Malignancy: (MAL)

There were 2 cases with malignancy operated in our study who presented as perforated gastric malignancy. 1 patient had lymph node metastasis and 1 patient had distant metastasis. Mortality was seen in both the patient. ($p < 0.05$; statistically significant)

Table 24: MAL vs. Outcome

MAL vs. OUTCOME			
MAL	Outcome of Surgery		Total
	Alive	Death	
1 if none	41	7	48
4 if nodal metastasis	0	1	1
8 if distant metastasis	0	1	1
Total	41	9	50

Graph 24: MAL vs. Outcome



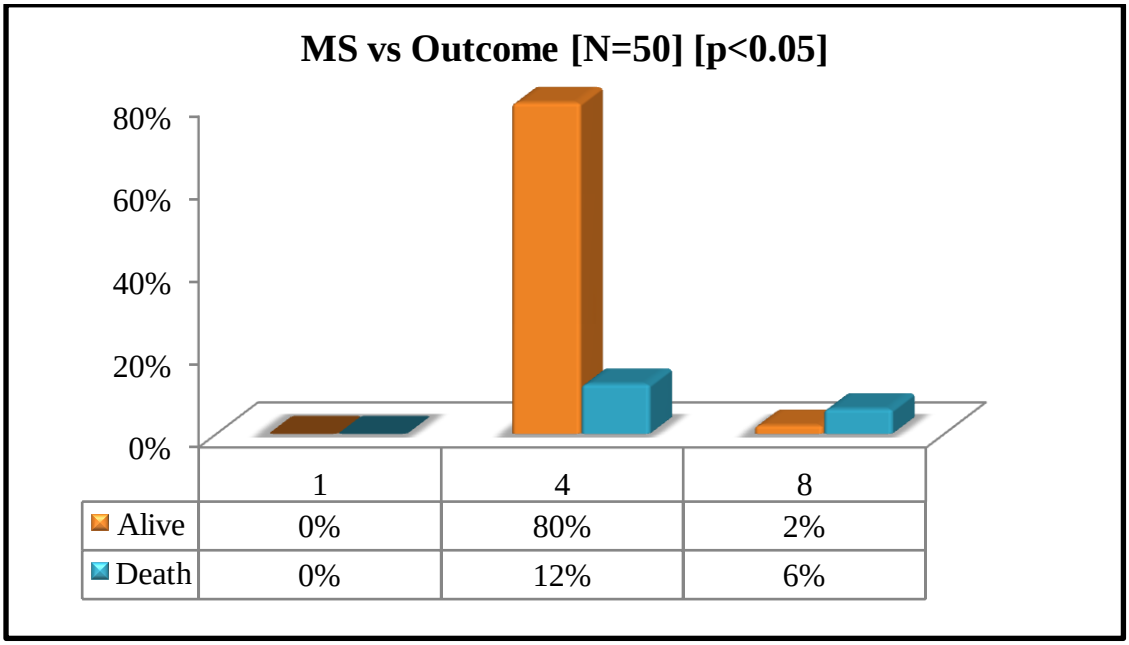
6. Mode of Surgery: (MS)

Out of 50 cases, in 46 patients (92%) resuscitation of >2 hours was possible with surgery being performed within 24 hours; death occurred in 6 patients (13%). 4 patients (8%) were such that immediate surgery within 2 hours of admission was done. Death occurred in 3 such patients (75%). ($p < 0.05$; statistically significant)

Table 25: MS vs. Outcome

MS vs. OUTCOME			
MS	Outcome of Surgery		Total
	Alive	Death	
1 if elective	0	0	0
4 if emergency resuscitation of >2 hours	40	6	46
8 if emergency immediate surgery <2 hours	1	3	4
Total	41	9	50

Graph 25: MS vs. Outcome



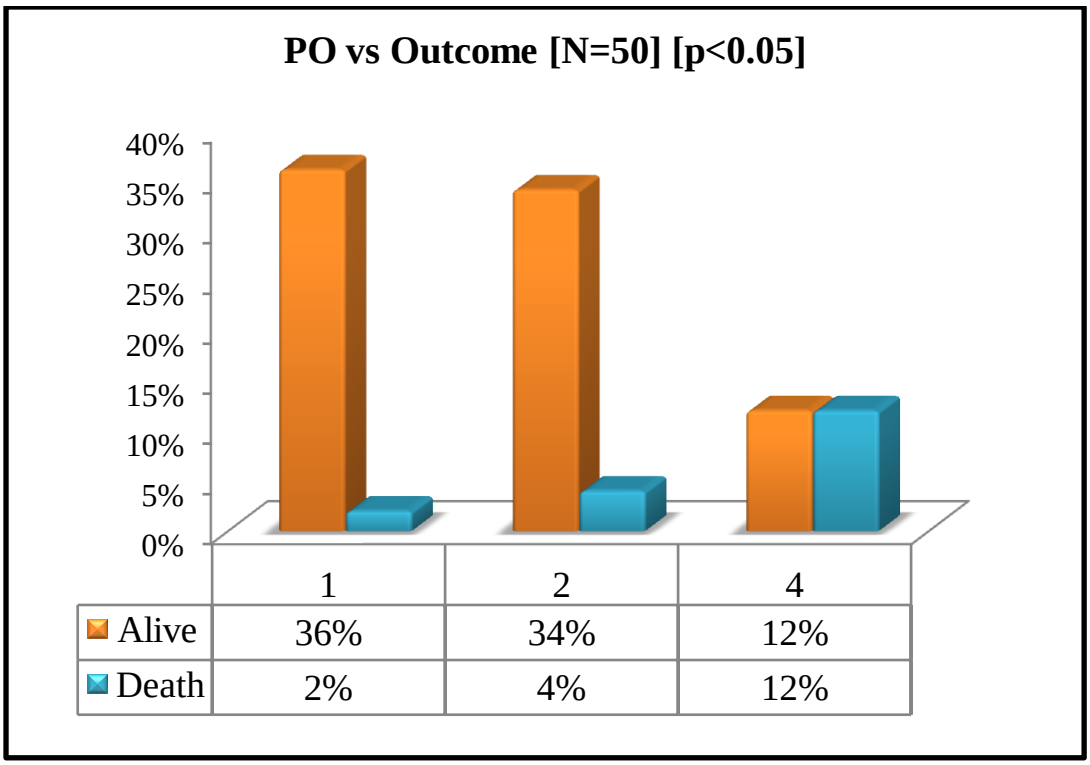
Perforation to Operation time (PO)

In our study we analyzed the mortality in patients with early and delayed perforation to operation time. Patients were categorized into 3 groups; group 1 with <24 hours, group 2 with 24 – 48 hours and group 3 with >74 hours duration. Statistically significant data were obtained in mortality of patients. Out of 19 patients in group 1, 1 death (5.3%) occurred and 18 patients were alive. Out of 19 patients in group 2, 2 deaths (10.5%) occurred and 17 patients survived. Out of 12 patients in group 3, 6 deaths (50%) occurred and 6 survived. ($p < 0.05$; statistically significant)

Table 26: PO vs. Outcome

PO vs. OUTCOME			
PO	Outcome of Surgery		Total
	Alive	Death	
1 if <24 hours	18	1	19
2 if 24 to 48 hours	17	2	19
4 if >48 hours	6	6	12
Total	41	9	50

Graph 26: PO vs. Outcome



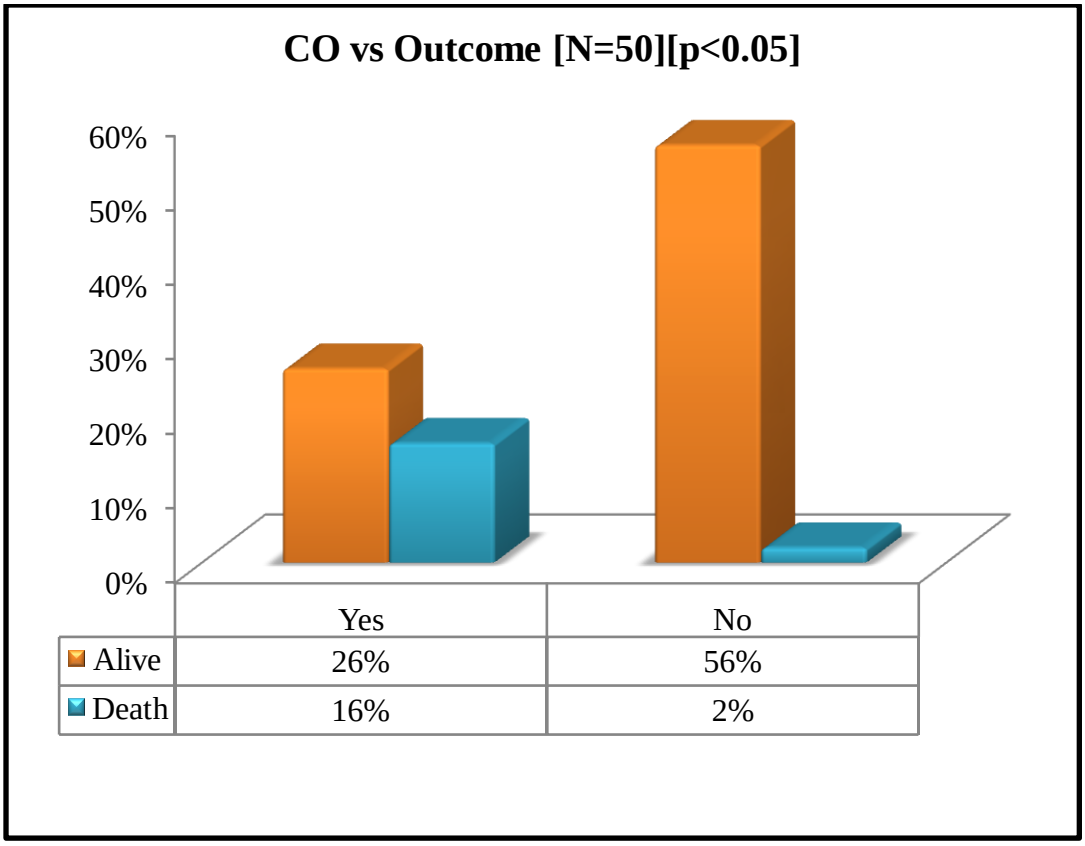
Co-morbid status (CO)

In our study we have analyzed the mortality in patients having co-morbidities like hypertension, diabetes mellitus, and asthma. Statistically significant differences were obtained based on the calculations. 8 deaths occurred among 21 patients with co-morbidity (38%), whereas 1 death was noted in 29 patients without any co-morbidity (3.4%). ($p<0.05$; statistically significant)

Table 27: CO vs. Outcome

CO vs. OUTCOME			
CO	Outcome of Surgery		Total
	Alive	Death	
Yes	13	8	21
No	28	1	29
Total	41	9	50

Graph 27: CO vs. Outcome



Using logistic equations, the predicted risk of mortality and morbidity was calculated and compared with the observed mortality and morbidity.

Table 28: Predicted risk of mortality

Predicted risk of mortality [derived from logistic equation]			
Observed	**Expected**		Total
	Alive	Death	
Alive	41	0	41
Death	2	7	9
Total	43	7	50
Overall Percentage	86%	14%	

Using the above table, the positive predictive value was 100%, negative predictive value 78%, sensitivity 95% and specificity 100% for mortality.

Table 29: Predicted risk of morbidity

Predicted risk of morbidity [derived from logistic equation]			
Observed	**Expected**		Total
	Uncomplicated	Complicated	
Uncomplicated	15	1	16
Complicated	6	28	34
Total	21	29	50
Overall Percentage	42%	58%	

Using the above table, the positive predictive value was 94%, negative predictive value 82%, sensitivity 71% and specificity 96% for morbidity.

DISCUSSION

The importance of surgical audit has increased over the past years both as a means of assessing the quality of surgical care and as an educational process. In this era, the use of crude mortality rate can be misleading.

A risk adjusted POSSUM was proposed to overcome these short comings. In a developing nation like India, due to poverty and ignorance the presentation of a particular illness is delayed leading to an increased number of death rates and complications. The use of POSSUM scoring system can identify those patients who are at increased risk of death or complications. However, POSSUM has to be correlated to the general condition of the local population to be more precise.

In this study the validity of POSSUM scoring system in 50 patients undergoing emergency laparotomy for perforative peritonitis was assessed by comparing the observed and expected mortality and morbidity rates. 9 patients died; a crude mortality rate of 18%. The most common cause of mortality was septicemia. Prytherach D R et al [31] obtained similar results of overall mortality rate of 19.1%. POSSUM predicted mortality rate in our study was 17.9%. On analysis we found no statistical difference between observed and expected mortality rate (χ^2 = 3.54, p = 0.316). An O: E ratio of 1.005 was obtained, similar finding was obtained by Prytherach D R et al [31] (O: E = 0.9), Sagar P M

[17] (O: E = 0.87) and Parihar V [24] (O: E = 0.97). Hence POSSUM was able to accurately predict the mortality rate following emergency surgery.

Out of 41 patients who survived, 25 patients suffered complications and the remaining 16 patients did not show any evidence of complications. An observed to expected ratio (O: E) of 1.001 was obtained and there was no significant difference between the predicted and observed values ($\chi^2 = 2.40$, $p = 0.792$).

The mean total POSSUM score of the study was 51.10. The mean total score of the mortality group was 69.56 whereas for survival group was 47.05. There was a significant statistical difference between the two groups; $p < 0.01$. This shows that patients with total POSSUM score more than 51.10 in our study had an increase in mortality.

Using logistic equations, positive predictive value was 100%, negative predictive value 78%, sensitivity 95% and specificity 100% for mortality. For morbidity, the positive predictive value was 94%, negative predictive value 82%, sensitivity 71% and specificity 96%.

On analysis of risk factors, statistically significant factors for mortality were respiratory system, blood pressure, Glasgow coma scale, serum sodium, and serum potassium, multiple procedures, and total blood loss, presence of malignancy and mode of surgery amongst the POSSUM scoring system factors.

Various causes like ventilation perfusion mismatch, impaired tissue perfusion and ischemia to vital organs, impaired mental status due to hyponatremia and hypokalemia, cancer cachexia and prolonged operative time could be attributed to the POSSUM scoring factors and hence post operative mortality.

In the study two risk factors were separately validated that affect the mortality significantly in patients with perforative peritonitis; perforation – operation time and presence of co-morbid status. A statistical significance was established with these factors.

Hence, strict vigilance and prompt correction of these factors can improve the general condition of the patient and decrease the mortality and morbidity. Also, general awareness, early referrals, early diagnosis and un-delayed treatment need to be implemented to reduce the perforation to operation time duration and control the co-morbidities.

In the study, septicemia was found in 5 cases (19%), deep infections 4 cases (15%), wound infections 4 cases (15%) chest infections 3 cases (12%) and multiple complications (wound dehiscence, deep infection, chest infection, urinary infection, impaired renal function and anastomotic leak) in 15 cases (58%). These complications can be attributed to gross peritoneal contamination, depressed immune function, raised diaphragm, upper abdominal incisions and presence of co-morbidities like asthma, COAD, diabetes mellitus, anemia and hypo-proteinemia.

SUMMARY

In this study 50 patients undergoing emergency laparotomy for peritonitis following hollow viscus perforation were evaluated. The study was conducted between December 2012 to November 2013 in Department of General Surgery, Coimbatore Medical College and Hospital, Coimbatore.

Out of the 50 emergency surgeries performed, 39 were major and 11 moderate. Indications for surgery included duodenal and antral perforation (27 cases), appendicular perforation (12 cases), ileal perforation (8 cases), gastric malignancy perforation (2 cases) and sigmoid volvulus perforation (1 case).

POSSUM scoring system was applied to score these patients on admission (physiological score) and intra-operatively (operative score). The patients were followed up for 4 weeks following surgery for an event of death or any complications.

9 patients died in our study (crude mortality rate 18%) and the expected mortality rate was 17.9%. There was no statistical difference between observed and POSSUM predicted mortality rates ($\chi^2 = 3.54$, $p = 0.316$; O: E = 1.005).

26 patients suffered complications. An observed to expected ratio (O: E) of 1.001 was obtained and there was no significant difference between the predicted and observed values ($\chi^2 = 2.40$, $p = 0.792$).

On analyzing factors such as respiratory system, blood pressure, Glasgow coma scale, serum sodium, and serum potassium, multiple procedures, and total blood loss, presence of malignancy, mode of surgery, perforation to operation time duration and co-morbid status were found to be significant.

Complications noted were septicemia (19%), deep infections (15%), wound infections (15%) chest infections (12%) and multiple (wound dehiscence, deep infection, chest infection, urinary infection, impaired renal function and anastomotic leak) in 58% cases.

The positive predictive value was 100%, negative predictive value 78%, sensitivity 95% and specificity 100% for mortality and for morbidity, the positive predictive value was 94%, negative predictive value 82%, sensitivity 71% and specificity 96%.

CONCLUSION

Out of 50 patients analyzed in our study, 9 deaths occurred (18% mortality rate). The expected mortality rate in our study was 17.9% (O: E = 1.005) using POSSUM scoring system. There was no statistical significant difference in the observed and expected mortality rates.

Out of 41 patients who survived, 26 patients suffered complications and the remaining 16 patients did not show any evidence of complications. An observed to expected ratio (O: E) of 1.001 was obtained and there was no significant difference between the predicted and observed values ($\chi^2 = 2.40$, $p = 0.792$).

The mean total POSSUM score also predicts the risk of mortality. The mean total POSSUM score of the study was 51.10. The mean total score of the mortality group was 69.56 whereas for survival group was 47.05. There was a significant statistical difference between the two groups; $p < 0.01$.

The positive predictive value was 100%, negative predictive value 78%, sensitivity 95% and specificity 100% for mortality. For morbidity, the positive predictive value was 94%, negative predictive value 82%, sensitivity 71% and specificity 96%.

In this study, factors such as respiratory system, blood pressure, Glasgow coma scale, serum sodium, and serum potassium, multiple procedures, and total

blood loss, presence of malignancy, mode of surgery were found to be significant statistically. Two factors were separately validated; perforation to operation time duration and co-morbid status and were found to be significant. Resuscitative efforts in the above mentioned factors can bring down the mortality in these patients.

Also higher number of deaths and complications occurred with higher POSSUM score. The complications of septicemia (19%), deep infections (15%), wound infections (15%) chest infections (12%) and others like wound dehiscence and anastomotic leak were observed in patients with higher total POSSUM score. Early diagnosis and prompt treatment can reduce these complications.

Findings of this study suggest that POSSUM scoring system can be used as a tool to predict the mortality and morbidity of patients operated for perforative peritonitis. Inclusion of factors like perforation to operation time and co-morbid status can improve the scoring system. Hence a modification in the scoring system according to the surgery will more improve the outcome of the patients and better care can be provided to them.

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APPENDIX I

PROFORMA OF THE CASE SHEET

NAME: AGE / SEX: I.P NO.:

D.O.A: D.O.S: D.O.D: UNIT:

DIAGNOSIS: PROCEDURE:

PHYSIOLOGICAL FACTORS	FINDINGS	SCORE
Age		
Cardiac signs		
ECG report		
Respiratory history		
Blood pressure		
Pulse rate		
Coma scale		
Hemoglobin		
White cell count		
Urea		
Sodium		
OPERATIVE FACTORS		
Operative complexity		
Multiple procedures		
Blood loss		
Peritoneal soiling		
Presence of malignant spread		
Mode of surgery		
Perforation – Operation time		
Co-morbid status		

COMPLICATIONS

NAME: AGE/SEX: I.P.NO.:

Hemorrhage

1. Wound
2. Deep
3. Other

Infection

1. Chest
2. Wound
3. Urinary tract
4. Deep
5. Septicemia
6. Pyrexia of unknown origin
7. Other

Anastomotic leak

Thrombosis

A. Deep vein thrombosis
B. Pulmonary embolus
C. Other
D. Cerebrovascular accident
E. Myocardial infarction

Cardiac failure

Impaired renal function (urea increases > 5mmol /L from pre-operative level)

Hypotension (< 90mmHg for 2 hours)

Respiratory failure

Any other complication

In the event of death, date of death

Post mortem findings

APPENDIX II

SAMPLE OF INFORMED CONSENT FORM

TITLE OF PROJECT: VALIDATION OF MODIFIED POSSUM

SCORING SYSTEM IN PERFORATIVE PERITONITIS

GUIDE: PROF. DR. D. N. RENGANATHAN M.S

P.G.STUDENT: DR. AMBARISH CHATTERJEE

PURPOSE OF RESEARCH:

I have been informed that this study will test the validity of modified POSSUM scoring system in perforative peritonitis.

PROCEDURE:

I understand that the scoring system needs various investigations to assign a score depending upon my status and also to confirm any morbidity / complications that could result. These investigations are part of routine evaluation of my management and they will be of help in my management.

RISKS AND DISCOMFORTS:

I understand that I may experience some pain and discomfort during the examination or during my treatment. This is mainly the result of my condition and it is not expected for the procedures of this study to exaggerate these feelings which are associated with the usual course of treatment.

BENEFITS:

I understand that my participation in the study will have no direct benefit to me other than the potential benefit of scoring to predict the outcome following my surgery.

CONFIDENTIALITY:

I understand that medical information produced by this study will become part of medical record and will be subjected to the confidentiality and privacy regulations of the said hospital. If the data is used for publications in medical literature or teaching procedures, no name will be used and any other identifiers such as photographs, audio and videotapes will be used only with my special written permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time. Dr. Ambarish Chatterjee at the department of surgery is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of the study which might influence my continued participation. A copy of this consent form will be handed to me for careful reading.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I understand that my participation is voluntary and that I may refuse to participate or withdraw consent and discontinue my participation in the study at any time without prejudice. I also understand that Dr. Ambarish Chatterjee may terminate my participation in the study at any time after explaining the reasons to do so.

INJURY STATEMENT:

I understand that in the unlikely event of injury resulting to me as a direct result of participation in the study, if such an injury were reported promptly the appropriate treatment would be available to me. But no further compensation would be provided by the hospital. I understand that my agreement to participate in the study and waiving of my legal rights. I have explained to _____the purpose of the research, the procedures required and the possible risks and benefits to the best of my ability.

_____ _____

(Investigator) (Date)

STUDY SUBJECT CONSENT STATEMENT:

I, hereby, confirm that Dr. Ambarish Chatterjee has explained to me, in my own language, the purpose of this research, the study procedure that I will undergo and the possible discomforts as well as benefits that I may experience. All the above has been explained to me in my own language and I understand the same. Therefore, I agree to give my consent and to participate in this research project as a subject.

_____ _____

(Participant) (Date)

_____ _____

(Witness to signature) (Date)

S.No.	NAME	I.P.no.	D.O.S	SEX	AGE	CVS	RS	BP	PR	GCS	HB	WBC	UREA	Na^+	K^+	ECG
1	Dhanapathi	70570	02.12.12	M	1	1	8	1	4	1	2	1	4	1	8	1
2	Raj	73533	06.12.12	M	1	1	4	1	4	1	1	1	4	8	2	1
3	Sarvanan	74460	08.12.12	M	1	1	4	2	2	1	2	1	4	1	1	1
4	Raman	75195	11.12.12	M	1	1	4	2	4	1	1	1	1	1	1	1
5	Selvaraj	75260	12.12.12	M	1	2	8	8	4	1	4	1	8	2	1	1
6	Gopi	76032	15.12.12	M	2	1	8	4	2	1	4	2	4	1	4	1
7	Binoy M	78366	27.12.12	M	2	1	8	2	8	1	2	2	2	4	4	1
8	Mala	125	01.01.13	F	1	1	4	1	8	1	2	1	4	1	1	1
9	Jindha	349	02.01.13	M	1	1	8	2	4	1	1	2	2	2	1	1
10	Natchiammal	904	05.01.13	F	2	2	8	2	8	1	2	1	4	2	1	1
11	Ajith K	1938	10.01.13	M	1	1	8	1	8	1	1	1	4	1	1	1
12	Mannu	1997	10.01.13	M	1	1	8	1	8	1	1	2	4	1	1	1
13	Amalraj	4149	22.01.13	M	1	1	8	2	8	1	2	2	8	2	4	1
14	Mannar M	4563	25.01.13	M	1	1	8	1	4	1	1	2	4	1	1	1
15	Cheniyappan	8912	14.02.13	M	1	1	8	1	8	1	4	2	8	1	1	1
16	Janaki	9036	17.02.13	M	2	1	8	2	8	1	4	1	8	2	2	1
17	Shahgad	14904	14.03.13	M	1	1	4	1	4	1	1	1	4	1	1	1
18	Muthusamy	14934	14.03.13	M	1	1	8	2	4	1	4	2	4	4	1	1
19	Siva	18621	04.04.13	M	1	1	8	4	8	1	4	2	8	4	4	1
20	Chinnappan	19648	04.04.13	M	1	1	4	1	8	1	1	2	4	1	1	1
21	Manthavachalam	21091	11.04.13	M	1	1	8	1	4	1	1	1	4	1	1	1
22	Jothimani	22663	13.04.13	F	1	1	4	1	4	1	4	2	4	1	1	1
23	Murugan	24238	25.04.13	M	1	1	8	1	8	1	4	2	8	1	1	1
24	Radhakrishnan	24910	29.04.13	M	1	1	8	8	8	1	1	4	8	1	1	1
25	Karumalayan	28794	16.05.13	M	1	1	8	2	4	1	4	1	1	1	1	1
26	Murugan	30250	23.05.13	M	1	1	8	1	8	1	1	2	8	1	1	1
27	Subramani	31541	29.05.13	M	1	1	8	4	8	2	4	2	8	4	4	1
28	Pathirban	36764	20.06.13	M	1	1	2	1	4	1	1	2	2	1	1	1

29	Thangavel	36909	21.06.13	M	1	1	8	4	2	1	4	1	8	1	1	1
30	Ameer Basha	38414	28.06.13	M	1	1	4	1	2	1	4	2	2	4	1	1
31	Balamahendran	41435	11.07.13	M	1	1	2	1	4	1	1	2	2	1	1	1
32	George Willaim	41492	12.07.13	M	1	1	8	8	8	1	4	2	8	1	4	1
33	Krishnan	43652	21.07.13	M	1	1	4	1	2	1	1	4	8	1	1	1
34	Kalyani	43690	22.07.13	F	4	4	8	1	4	1	2	1	8	2	1	1
35	Selvaraj	44546	25.07.13	M	1	1	8	2	8	1	4	1	8	1	1	1
36	Sarabanadhani	47571	08.08.13	M	1	1	4	2	4	1	4	2	4	4	1	1
37	Pattiammal	52355	29.08.13	F	4	1	4	2	4	1	4	2	8	1	1	1
38	Bhuwaneshwaran	52922	01.09.13	M	1	1	4	1	4	1	1	2	2	1	1	1
39	Ubaithul Rahman	52939	01.09.13	M	1	1	8	1	4	1	1	2	8	1	1	1
40	Priya	53400	13.09.13	F	1	1	2	1	4	1	4	2	2	1	1	1
41	Chellammal	55953	22.09.13	F	2	1	8	8	8	4	8	2	8	1	8	1
42	Subramani	58549	27.09.13	M	2	1	8	2	8	1	1	1	8	1	1	1
43	Shaktivel	59965	03.10.13	M	1	1	8	8	8	2	4	2	8	1	4	1
44	Subramani	61578	10.10.13	M	4	1	8	2	8	1	2	2	8	4	4	1
45	Padavattan	61693	10.10.13	M	1	1	4	1	4	1	1	1	2	1	1	1
46	Abiba	63214	16.10.13	M	1	1	4	1	8	1	4	2	1	1	1	1
47	Kumar	64625	25.10.13	M	2	1	4	1	2	1	1	1	2	2	1	1
48	Prabhu	65964	31.10.13	M	1	1	8	2	4	1	1	2	2	1	1	1
49	Mannikam	69831	17.11.13	M	1	1	8	1	2	1	2	4	2	2	1	1
50	Deepalakshmi	69919	17.11.13	F	1	1	4	1	4	1	8	4	4	1	1	1

S.No.	NAME	I.P.no.	D.O.S	SEX	OC	MP	TBL	PS	MAL	MS	TS	PO	CM	EM%	ED%	IN	O	CO
1	Dhanapathi	70570	02.12.12	M	4	1	2	8	1	4	53	2	-	96	61.1	b	+	a
2	Raj	73533	06.12.12	M	4	1	2	8	1	4	49	2	-	92.6	48.3	b	+	e
3	Sarvanan	74460	08.12.12	M	4	1	2	8	1	4	41	2	-	77.7	24.8	b	+	d
4	Raman	75195	11.12.12	M	4	1	2	8	1	4	39	1	-	71.4	20.3	b	+	-
5	Selvaraj	75260	12.12.12	M	4	1	2	8	1	4	61	2	HT	98.8	81.6	b	+	h
6	Gopi	76032	15.12.12	M	4	8	2	8	8	4	68	2	COAD	99.8	94.4	a	-	g,o
7	Binoy M	78366	27.12.12	M	4	1	2	8	1	4	57	2	HT	97.8	72.5	b	+	b
8	Mala	125	01.01.13	F	2	1	1	4	1	4	49	1	-	67.3	17.3	d	+	-
9	Jindha	349	02.01.13	M	4	1	4	8	1	4	48	2	-	91.9	46.5	b	+	b
10	Natchiammal	904	05.01.13	F	4	1	2	8	1	4	55	2	DM,HT	96.5	64.1	b	+	b,d,e
11	Ajith K	1938	10.01.13	M	4	1	2	8	1	4	49	4	AS	92.6	48.3	b	+	b,d,e
12	Mannu	1997	10.01.13	M	4	1	2	8	1	4	50	1	-	93.6	51.5	b	+	-
13	Amalraj	4149	22.01.13	M	4	1	2	8	1	4	60	4	COAD	98.6	79.6	c	+	a,b,d,e
14	Mannar M	4563	25.01.13	M	4	1	2	8	1	4	46	1	-	88.6	38.7	b	+	-
15	Cheniyappan	8912	14.02.13	M	4	1	2	8	1	4	57	2	COAD	97.8	72.5	b	+	e
16	Janaki	9036	17.02.13	M	4	1	2	8	1	4	60	4	HT	98.6	79.6	b	+	b,d,e
17	Shahgad	14904	14.03.13	M	4	1	2	8	1	4	41	2	-	77.7	24.8	b	+	-
18	Muthusamy	14934	14.03.13	M	4	4	2	8	1	4	56	4	COAD	97.7	71.7	c	-	g
19	Siva	18621	04.04.13	M	4	1	2	8	1	4	67	4	-	99.5	89.5	c	-	g
20	Chinnappan	19648	04.04.13	M	2	1	1	2	1	4	37	1	-	58.4	13.0	d	+	d
21	Mathavachalam	21091	11.04.13	M	4	1	2	8	1	4	45	2	COAD, HT	86.9	35.7	b	+	e
22	Jothimani	22663	13.04.13	F	2	1	1	4	1	4	38	2	-	63.6	15.3	d	+	b,d
23	Murugan	24238	25.04.13	M	4	1	2	8	1	4	57	4	COAD	97.8	72.5	c	+	b
24	Radhakrishnan	24910	29.04.13	M	4	1	2	8	1	4	63	4	COAD, DM	99.2	85.2	b	-	n,o
25	Karumalayan	28794	16.05.13	M	4	1	2	8	1	4	46	1	-	88.6	38.7	b	+	b,d,e
26	Murugan	30250	23.05.13	M	4	1	2	8	1	4	54	1	-	96.5	64.1	b	+	-

27	Subramani	31541	29.05.13	M	4	4	2	8	1	8	74	4	COAD	99.9	96.7	c	-	g
28	Pathirban	36764	20.06.13	M	2	1	1	2	1	4	29	1	-	28.1	5.0	d	+	-
29	Thangavel	36909	21.06.13	M	4	1	2	8	1	4	53	4	COAD	96.0	61.1	c	-	g
30	Ameer Basha	38414	28.06.13	M	4	1	2	8	1	4	44	1	-	84.9	32.7	b	+	-
31	Balamahendran	41435	11.07.13	M	2	1	1	2	1	4	34	1	-	28.1	5.0	d	+	-
32	George Willaim	41492	12.07.13	M	4	4	2	8	1	8	74	4	COAD	99.9	96.9	c	+	b,d,e,m
33	Krishnan	43652	21.07.13	M	4	1	2	8	1	4	46	1	-	88.6	38.7	b	+	-
34	Kalyani	43690	22.07.13	F	4	1	2	8	1	4	57	4	AS	97.8	72.5	b	+	d,e
35	Selvaraj	44546	25.07.13	M	4	1	2	8	1	4	57	2	-	97.8	72.5	c	+	a,b
36	Sarabanadhani	47571	08.08.13	M	4	1	2	8	1	4	49	1	-	92.6	48.3	b	+	-
37	Pattiammal	52355	29.08.13	F	2	1	1	4	1	4	46	2	AS	86.3	33.8	d	+	d,e
38	Bhuwaneshwaran	52922	01.09.13	M	4	1	1	4	1	4	45	2	-	53.5	11.5	d	+	b,d,e
39	Ubaithul Rahman	52939	01.09.13	M	2	1	1	4	1	4	30	2	-	79.6	25.7	d	+	b
40	Priya	53400	13.09.13	F	2	1	1	2	1	4	29	1	-	38.7	7.2	d	+	-
41	Chellammal	55953	22.09.13	F	4	8	8	8	4	8	103	2	HT	100	99.9	a	-	k
42	Subramani	58549	27.09.13	M	4	1	2	8	1	4	55	2	COAD	97.0	67.0	b	+	b,d,e,i
43	Shaktivel	59965	03.10.13	M	4	4	4	8	1	8	77	1	MR	99.9	99.7	e	-	g
44	Subramani	61578	10.10.13	M	4	1	2	8	1	4	65	4	COAD	99.4	88.2	b	-	l,n,o
45	Padavattan	61693	10.10.13	M	2	1	1	4	1	4	32	1		40.1	7.7	d	+	d
46	Abiba	63214	16.10.13	M	2	1	1	4	1	4	39	1	-	67.3	17.1	d	+	-
47	Kumar	64625	25.10.13	M	4	1	2	8	1	4	39	1	-	71.7	20.3	b	+	-
48	Prabhu	65964	31.10.13	M	4	1	2	8	1	4	45	1	-	86.9	35.7	b	+	-
49	Mannikam	69831	10.11.13	M	4	1	2	8	1	4	46	1	-	88.6	38.7	b	+	-
50	Deepalakshmi	69919	10.11.13	F	2	1	1	4	1	4	44	2	-	82.1	28.3	d	+	d

KEY TO MASTER CHART

S.No. – Serial Number

Name – Name of the patient

I.P No. – Inpatient number

DOS – Date of Surgery

Sex – Male (M) or female (F)

Age – Divided into 3 groups

1 if <60 years

2 if 61 to 70 years

4 if > 71 years

CVS – Cardiovascular System – Divided into 4 groups

1 if no failure

2 if diuretic, digoxin, anti-anginal or oral antihypertensive therapy

4 if peripheral edema, warfarin therapy, borderline cardiomegaly

8 if raised jugular venous pressure, cardiomegaly

RS – Respiratory system – Divided into 4 groups

1 if no dyspnea

2 if dyspnea on exertion

4 if limiting dyspnea (one flight of stairs), mild COAD

8 if dyspnea at rest (≥30/min), fibrosis or consolidation

BP – Blood pressure – Divided into 4 groups

1 if 110-130mm Hg systolic

2 if 131-170mmHg systolic

4 if ≥171, 90-99mmHg systolic

8 if ≤89 mmHg systolic

PR – Pulse rate – Divided into 4 groups

1 if 50-80 beats/min

2 if 81-100, 40-49 beats/min

4 if 101-120 beats/min

8 if ≥121, ≤39 beats/min

GCS – Glasgow coma scale – Divided into 4 groups

1 if scale is 15

2 if scale is 12-14

4 if scale is 9-11

8 if scale is ≤8

HB – Hemoglobin g/dl – Divided into 4 groups

1 if 13-16 g/dl

2 if 11.5-12.9 or 16.1-17 g/dl

4 if 10-11.4 or 17.1-18 g/dl

8 if ≤9.9 or ≥18.1 g/dl

WBC – White cell count (x 10^{12}/l) – Divided into 3 groups

1 if 4-10 (x 10^{12}/l)

2 if 10.1-20 or 3.1-4 (x10^{12}/l)

4 if ≥20.1 or ≤3.1 (x10^{12}/l)

UREA (mmol/l) – Divided into 4 groups

1 if ≤7.5 (mmol/l)

2 if 7.6-10 (mmol/l)

4 if 10.1 15 (mmol/l)

8 if ≥15.1 (mmol/l)

Na+ - Serum sodium (mmol/l) – Divided into 4 groups

1 if ≥ 136 (mmol/l)

2 if 131-150 (mmol/l)

4 if 126-130 (mmol/l)

8 if ≤125 (mmol/l)

K+ - Serum potassium (mmol/l) – Divided into 4 groups

1 if 3.5-5.0 (mmol/l)

2 if 3.2-3.4 or 5.2-5.3 (mmol/l)

4 if 2.9-3.1 or 5.4-5.9 (mmol/l)

8 if ≤2.8 or ≥6 (mmol/l)

ECG – Electrocardiogram – Divided into 3 groups

1 if normal

4 if atrial fibrillation (rate 60-90)

8 if any other abnormal rhythm or >5 ectopics/min, Q waves or ST/T wave changes

OC – Operative Complexity – Divided into 4 groups

1 if minor

2 if moderate

4 if major

8 if major +

MP – Multiple procedures – Divided into 3 groups

1 if single procedure

2 if 2 procedures

8 if >2 procedures

BL – Blood loss (ml) – Divided into 4 groups

1 if <100 (ml)

2 if 100-500 (ml)

4 if 501-999 (ml)

8 if ≥ 1000 (ml)

PS – Peritoneal Soiling – Divided into 4 groups

1 if none

2 if minor (serous fluid)

4 if local pus

8 if free bowel contents, pus or blood

MAL – Presence of malignancy – Divided into 4 groups

1 if none

2 if primary only

4 if nodal metastasis

8 if distant metastasis

MODE – Mode of Surgery – Divided into 3 groups

1 if elective

4 if emergency resuscitation of >2 hours possible, operation <24 hours after admission

8 if emergency immediate surgery <2 hours needed

TS – Total score – it is the sum of all the risk factors under study

PO – Perforation to operation time duration – divided into 3 groups

1 if <24 hours

2 if 24 to 48 hours

4 if >48 hours

CM – Co-morbid status

(-) if no co-morbidity

HT – Hypertension

COAD – Chronic Obstructive Airway Disease

AS – Asthma

DM – Diabetes Mellitus

MR – Mental Retardation

EM% - Expected morbidity in percentage

ED% - Expected mortality in percentage

IN – Indication for surgery

a. Gastric malignancy perforation
b. Duodenal and antral perforation
c. Ileal perforation
d. Appendicular perforation
e. Sigmoid Volvulus perforation

O – Outcome of surgery, (+) = alive and (-) = dead

CO - Complications

a. Urinary tract infection
b. Deep infection

c. Deep hematoma
d. Wound infection
e. Chest infection
f. Wound hematoma
g. Septicemia
h. Pyrexia of unknown origin
i. Wound dehiscence
j. Deep venous thrombosis and pulmonary embolism
k. Impaired renal function
l. Cardiac failure
m. Anastomotic leak
n. Respiratory failure
o. Hypotension